KEMENTERIAN PENDIDIKAN MALAYSIA

KURIKULUM STANDARD SEKOLAH MENENGAH

Matematik

Dokumen Standard Kurikulum dan Pentaksiran

Tingkatan 1

EDISI BAHASA INGGERIS

KEMENTERIAN PENDIDIKAN MALAYSIA

KURIKULUM STANDARD SEKOLAH MENENGAH

Matematik

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Tingkatan 1

Edisi Bahasa Inggeris

Bahagian Pembangunan Kurikulum

Mei 2016

CONTENT

Content Details

RUKUN NEGARA

BAHAWASANYA Negara kita Malaysia mendukung cita-cita hendak:
Mencapai perpaduan yang lebih erat dalam kalangan seluruh masyarakatnya;
Memelihara satu cara hidup demokratik;
Mencipta satu masyarakat yang adil di mana kemakmuran negara
akan dapat dinikmati bersama secara adil dan saksama;
Menjamin satu cara yang liberal terhadap tradisi-tradisi
kebudayaannya yang kaya dan berbagai corak;
Membina satu masyarakat progresif yang akan menggunakan
sains dan teknologi moden;

MAKA KAMI, rakyat Malaysia, berikrar akan menumpukan seluruh tenaga dan usaha
kami untuk mencapai cita-cita tersebut berdasarkan prinsip-prinsip yang berikut:

KEPERCAYAAN KEPADA TUHAN
KESETIAAN KEPADA RAJA DAN NEGARA
KELUHURAN PERLEMBAGAAN
KEDAULATAN UNDANG-UNDANG
KESOPANAN DAN KESUSILAAN

FALSAFAH PENDIDIKAN KEBANGSAAN

"Pendidikan di Malaysia adalah suatu usaha berterusan ke arah lebih memperkembangkan potensi individu secara menyeluruh dan bersepadu untuk melahirkan insan yang seimbang dan harmonis dari segi intelek, rohani, emosi dan jasmani, berdasarkan kepercayaan dan kepatuhan kepada Tuhan. Usaha ini adalah bertujuan untuk melahirkan warganegara Malaysia yang berilmu pengetahuan, berketerampilan, berakhlak mulia, bertanggungjawab dan berkeupayaan mencapai kesejahteraan diri serta memberikan sumbangan terhadap keharmonian dan kemakmuran keluarga, masyarakat dan negara"

Sumber: Akta Pendidikan 1996 (Akta 550)

DEFINISI KURIKULUM KEBANGSAAN

"3(1) Kurikulum Kebangsaan ialah suatu program pendidikan yang termasuk kurikulum dan kegiatan kokurikulum yang merangkumi semua pengetahuan, kemahiran, norma, nilai, unsur kebudayaan dan kepercayaan untuk membantu perkembangan seseorang murid dengan sepenuhnya dari segi jasmani, rohani, mental dan emosi serta untuk menanam dan mempertingkatkan nilai moral yang diingini dan untuk menyampaikan pengetahuan."

Sumber:Peraturan-Peraturan Pendidikan (Kurikulum Kebangsaan) 1996

[PU(A)531/97]

KATA PENGANTAR

Kurikulum Standard Sekolah Menengah (KSSM) yang dilaksanakan secara berperingkat mulai tahun 2017 akan menggantikan Kurikulum Bersepadu Sekolah Menengah (KBSM) yang mula dilaksanakan pada tahun 1989. KSSM digubal bagi memenuhi keperluan dasar baharu di bawah Pelan Pembangunan Pendidikan Malaysia (PPPM) 2013-2025 agar kualiti kurikulum yang dilaksanakan di sekolah menengah setanding dengan standard antarabangsa. Kurikulum berasaskan standard yang menjadi amalan antarabangsa telah dijelmakan dalam KSSM menerusi penggubalan Dokumen Standard Kurikulum dan Pentaksiran (DSKP) untuk semua mata pelajaran yang mengandungi Standard Kandungan, Standard Pembelajaran dan Standard Pentaksiran.

Usaha memasukkan Standard Pentaksiran di dalam dokumen kurikulum telah mengubah landskap sejarah sejak Kurikulum Kebangsaan dilaksanakan di bawah Sistem Pendidikan Kebangsaan. Menerusinya murid dapat ditaksir secara berterusan untuk mengenalpasti tahap penguasaannya dalam sesuatu mata pelajaran, serta membolehkan guru membuat tindakan susulan bagi mempertingkatkan pencapaian murid.

DSKP yang dihasilkan juga telah menyepadukan enam tunjang Kerangka KSSM, mengintegrasikan pengetahuan, kemahiran dan nilai, serta memasukkan secara eksplisit Kemahiran Abad ke-21 dan Kemahiran Berfikir Aras Tinggi (KBAT). Penyepaduan tersebut dilakukan untuk melahirkan insan seimbang dan harmonis dari segi intelek, rohani, emosi dan jasmani sebagaimana tuntutan Falsafah Pendidikan Kebangsaan.

Bagi menjayakan pelaksanaan KSSM, pengajaran dan pembelajaran (p&p) guru perlu memberi penekanan kepada KBAT dengan memberi fokus kepada pendekatan Pembelajaran Berasaskan Inkuiri dan Pembelajaran Berasaskan Projek, supaya murid dapat menguasai kemahiran yang diperlukan dalam abad ke- 21.

Kementerian Pendidikan Malaysia merakamkan setinggi-tinggi penghargaan dan ucapan terima kasih kepada semua pihak yang terlibat dalam penggubalan KSSM. Semoga pelaksanaan KSSM akan mencapai hasrat dan matlamat Sistem Pendidikan Kebangsaan.

Dr. SARIAH BINTI ABD. JALIL
Pengarah
Bahagian Pembangunan Kurikulum

INTRODUCTION

Mathematics KSSM is a core subject that must be taken by all pupils who go through the National Education System. Each pupil has the opportunity to go through at least six years of basic education in the primary schools and five years in the secondary schools. Mathematics programme at the secondary level is divided into three programmes: Mathematics at the lower secondary, Mathematics at the upper secondary and Additional Mathematics at the upper secondary.

The secondary school Mathematics content is essentially a continuation of the knowledge and skills learnt at the primary school level. Secondary school Mathematics aims, among others, to develop the knowledge and skills of the pupils to enable them to solve problems in their daily lives, further their studies to a higher level and thus function as an effective workforce.

Rearrangement of Mathematics KSSM takes into consideration continuity from primary school to secondary school and onto a higher level. In addition, benchmarking of the Mathematics Curriculum in Malaysia with high performing countries in the international assessments has been carried out. This measure is to ensure that the Mathematics Curriculum in Malaysia is relevant and at par with other countries in the world. In order to develop individual's potential, intellectual proficiency and human capital, mathematics is the best medium because of its nature that encourages logical and systematic thinking. Thus, the development of the mathematics curriculum takes into consideration the needs of developing the country, and factors that contribute to the development of individuals who can think logically, critically, analytically, creatively and innovatively. This is consistent with the need to provide adequate mathematical knowledge and skills to ensure that the country is able to compete internationally and to meet the challenges of the 21st century. The different backgrounds and abilities of the pupils are given special attention in determining the knowledge and skills learned in the programme.

AIMS

Mathematics KSSM aims to produce individuals who are mathematically *fikrah*, which means individuals who can

think mathematically, creative and innovative as well as competent in applying mathematical knowledge and skills effectively and responsibly to solve problems and make decisions, based on the attitudes and values so that they are able to deal with challenges in their daily lives, in line with the development of science and technology as well as the challenges of the 21st century.

OBJECTIVES

Mathematics KSSM enables pupils to achieve the following objectives:

1. Develop an understanding of the concepts, laws, principles and theorems related to Numbers and Operations; Measurement and Geometry; Relationship and Algebra; Statistics and Probability, and Discrete Mathematics.

2. Develop capacity in:

   - formulating situations into mathematical forms;
   - using concepts, facts, procedures and reasoning; and

   - interpreting, applying and evaluating mathematical outcomes.

3. Apply the knowledge and skills of mathematics in making reasonable judgements and decisions to solve problems in a variety of contexts.

4. Enhance mathematical skills related to Number and Operations; Measurement and Geometry; Relationship and Algebra; Statistics and Probability, and Discrete Mathematics such as:

   - collecting and handling data
   - representing and interpreting data
   - recognising relationship and representing them mathematically
   - using algorithms and relationship
   - making estimation and approximation; and
   - measuring and constructing

5. Practise consistently the mathematical process skills that are problem-solving; reasoning; mathematical communication; making connection; and representation.

6. Cultivate the use of mathematical knowledge and skills in making reasonable judgments and decisions effectively and responsibly in real-life situations.

7. Realise that mathematical ideas are inter-related, comprehensive and integrated body of knowledge, and are able to relate mathematics with other disciplines of knowledge.

8. Use technology in concept building, mastery of skills, investigating and exploring mathematical ideas and problems solving.

9. Foster and practice good moral values, positive attitudes towards mathematics and appreciate the importance and the beauty of mathematics.

10. Develop higher-order, critical, creative and innovative thinking; and

11. Practise and develop generic skills to face challenges of the 21st century.

THE FRAMEWORK OF SECONDARY SCHOOL STANDARD-BASED CURRICULUM

KSSM Framework is built on the basis of six fundamental strands: communication, spiritual, attitude and values, humanities, personal competence, physical development and aesthetics, and science and technology. These six strands are the main domain that support one another and are integrated with critical, creative and innovative thinking. The integration aims to produce human capitals who appreciate values based on spiritual, knowledge, personal competence, critical and creative thinking as well as innovative as shown in Figure 1.
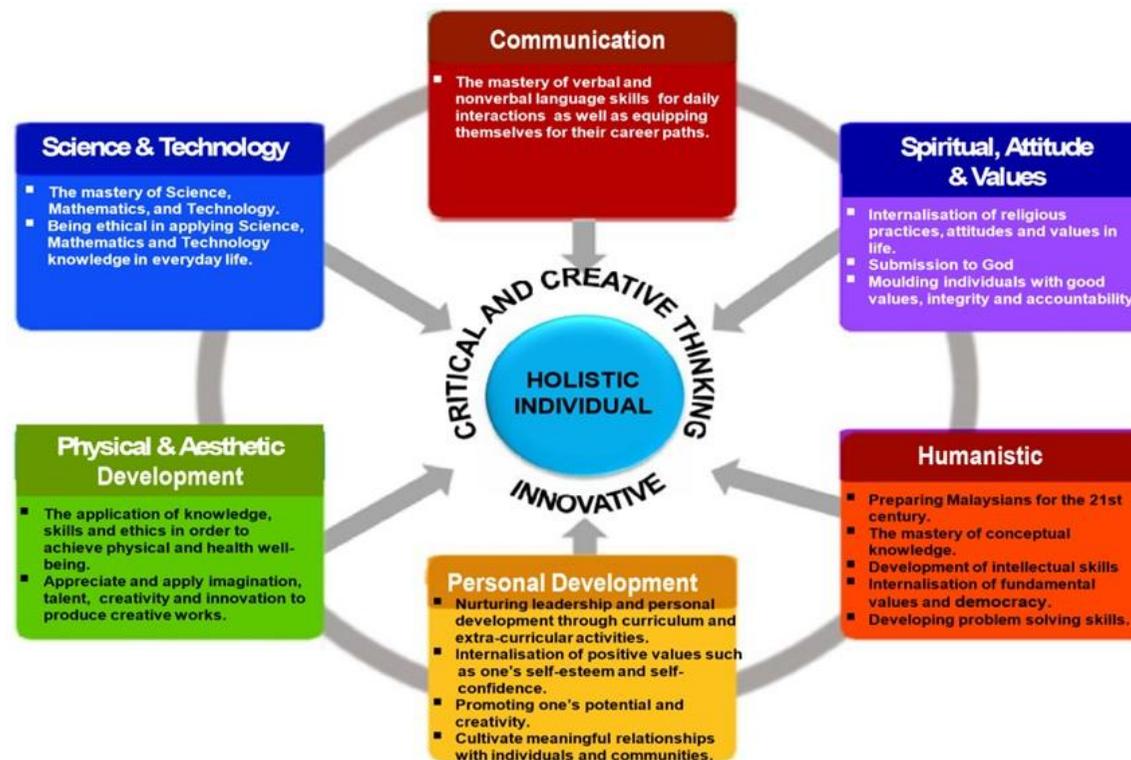
Figure 1: The Framework of Secondary School Standard-Based Curriculum

4

FOCUS

Mathematics KSSM focuses on developing individuals who internalise and practise mathematical *fikrah*. The Mathematics Curriculum Framework as illustrated in Figure 2, is fundamental to the implementation of the mathematics curriculum in the classroom. Four key elements that contribute to the development of human capital possessing mathematical *fikrah* are:

• Learning areas
• Values
• Skills
• Mathematical processes
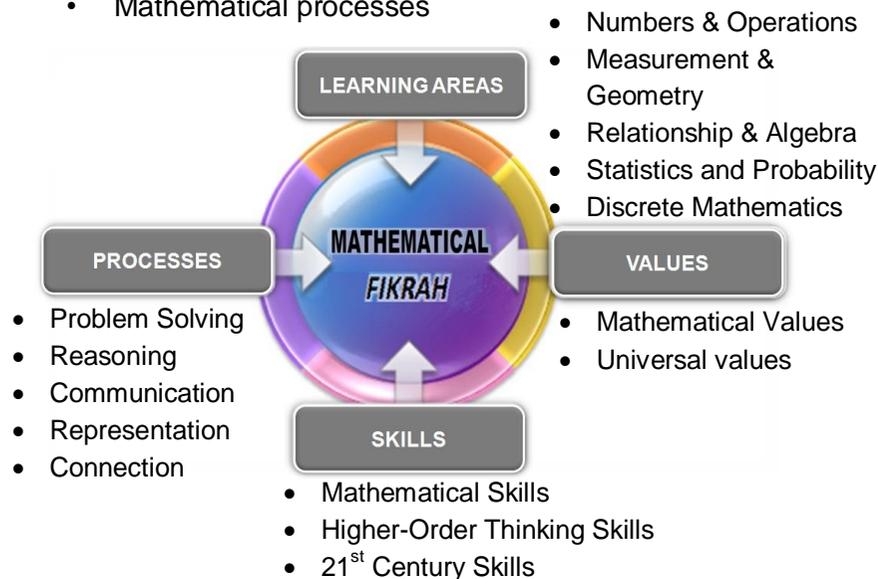
Figure 2: The Mathematics Curriculum Framework of Secondary Schools

Mathematical *Fikrah*

In the Fourth Edition of Kamus Dewan (2005), *fikrah* has the same meaning as the power of thought or thinking. In the context of mathematics education, mathematical *fikrah* refers to the quality of pupils to be developed through the national mathematics education system. Pupils who acquired mathematical *fikrah* is capable of doing mathematics, understanding mathematical ideas, and applying the knowledge and skills of mathematics responsibly in daily life, guided by good attitudes and values. Mathematical *Fikrah* also intends to produce individuals who are creative and innovative and well-equipped to face the challenges of the 21st century, as the country is highly dependent on the ability of human capital to think and generate new ideas.

Learning Area

Mathematical content covers five main areas of learning that are inter-related, namely:

• Number and Operations;
• Measurement and Geometry;

- Relationship and Algebra;
- Statistics and Probability; and
- Discrete Mathematics.

Mathematical Proceses

Mathematical processes that support effective and meaningful teaching and learning are:

- Problem solving;
- Reasoning;
- Mathematical communication;
- Making connection; and
- Representation.

These five inter-related mathematical processes need to be implemented and integrated across the curriculum.

Problem solving

Problem solving is the 'heart' of mathematics. Hence, problem-solving skills need to be developed comprehensively and integrated across the mathematics curriculum. In accordance with the importance of problem solving, mathematical processes are the backbone of the teaching and learning of mathematics and should be able to produce pupils who are capable of using a variety of problem-solving strategies, higher-order, critical, creative and innovative thinking skills. Teachers need to design teaching and learning sessions that make problem solving the focus of the discussion. Activities carried out should engage the pupils actively and pose a diversity of questions and tasks that contain not only the routine questions but non-routine questions as well. Solving problems involving non-routine questions basically needs thinking and reasoning at a higher level. These skills should be cultivated consistently by the teachers to produce pupils who are able to compete in the global market.

The following problem-solving steps should be emphasized so that pupils can solve problems systematically and effectively:

- Understanding and interpreting the problem;
- Devising a plan;
- Implementing the strategy; and
- Doing reflection.

The application of various strategies in problem-solving including the steps involved has to be used widely. Among the strategies commonly used are: drawing diagrams, identifying patterns, making tables/charts or systematic list; using algebra, trying simpler cases, reason out logically, using trial and improvement, making simulation, working backwards as well as using analogies.

The followings are some of the processes that need to be emphasized and developed through problem-solving to develop pupils' capacity in:

- Formulating situations involving various contexts mathematically;
- Using and applying concepts, facts, procedures and reasonings in solving problems; and
- Interpreting, evaluating and reflecting on the solutions or decisions and determine whether they are reasonable.

Reflection is an important step in problem solving. Reflection allows pupils to see, understand and appreciate perspective of others from different angles as well as enables pupils to consolidate their understanding of the concepts learned.

Reasoning

Reasoning is an important basis for understanding mathematics more effectively and meaningfully. The development of mathematical reasoning is closely related to pupils' intellectual development and communication. Reasoning is not only able to develop the capacity of logical thinking but also to increase the capacity of critical thinking that is fundamental to the understanding of mathematics in depth and meaningfully. Therefore, teachers need to provide space and opportunity through designing teaching and learning activities that require pupils to do the mathematics and be actively involved in discussing mathematical ideas.

The elements of reasoning in the teaching and learning would prevent pupils from considering mathematics as just a set of procedures or algorithms that should be followed to obtain a solution without understanding the actual mathematical concepts in depth. Reasoning is not only changing the paradigm of pupils' conscious procedural knowledge but also giving thought and intellectual empowerment when pupils are guided and trained to make and validate conjectures to provide logical explanations, analyze, evaluate and justify the mathematical activities.

Such training would enhance pupils' confidence and courage, in line with the aim of developing powerful mathematical thinkers.

Communication

Communication in mathematics is the process of expressing ideas and understanding verbally, visually or in written form using numbers, notations, symbols, diagrams, graphs, pictures or words. Communication is an important process in learning mathematics because communication helps pupils to clarify and reinforce their understanding of mathematics. Through communication, mathematical ideas can be better expressed and understood. Communication in mathematics, either orally, in written form or using symbols and visual representations (charts, graphs, diagrams, etc), help pupils understand and apply mathematics more effectively.

Through appropriate questioning techniques, teachers should be aware of the opportunities that exist in the teaching and learning sessions that allow them to encourage pupils to express and present their mathematical ideas. Communication that involves a variety of perspectives

and point of views help pupils to improve their mathematical understanding and self-confidence.

The significant aspect of mathematical communication is the ability to provide effective explanation, as well as to understand and apply the correct mathematical notations. Pupils should use the mathematical language and symbols correctly to ensure that a mathematical idea can be explained precisely.

Effective communication requires an environment that is always sensitive to the needs of pupils so that they feel comfortable while talking, asking and answering questions, explaining and justifying their views and statements to classmates and teachers. Pupils should be given the opportunity to communicate actively in a variety of settings, for example while doing activities in pairs, groups or while presenting information to the whole class.

Representation

Mathematics is often used to represent real-world phenomena. Therefore, there must be a similarity between the aspects of the world and the world represented.

Representation is the use of notations, letters, images or concrete objects that represents something else.

Representation is an important component of mathematics. At the secondary school level, representing ideas and mathematical models generally make use of symbols, geometry, graphs, algebra, figures, concrete representations and dynamic softwares. Pupils must be able to change from one form of representation to another and recognize the relationship between them and use various representations, which are relevant and required to solve problems.

The use of various representations helps pupils to understand mathematical concepts and relationships; communicate their thinking, reasoning and understanding; recognize the relationship between mathematical concepts and use mathematics to model situations, physical and social phenomena. When pupils are able to represent concepts in different ways, they are flexible in their thinking and understand that there are a variety of ways to represent mathematical ideas that enable the problem to be solved more easily.

Connection

The mathematics curriculum consists of a number of areas such as counting, geometry, algebra, measurement, and statistics. Without making the connection between these areas, pupils will learn concepts and skills separately. Instead, by recognizing how the concepts or skills of different areas are related to each other, mathematics will be seen and studied as a discipline that is comprehensive, connected to each other thus allowing abstract concepts to be understood easily.

When mathematical ideas are connected to daily life experiences inside and outside the schools, pupils will be more conscious of the use, the importance, the power and the beauty of mathematics. In addition they are also able to use mathematics contextually in other discipline and in their daily lives. Mathematical models are used to describe real-life situations mathematically. Pupils will realise that this can be used to solve a problem or to predict the likelihood of a situation.

In carrying out the mathematics curriculum, the opportunity in making connection should be established so that pupils

9

can relate conceptual knowledge to the procedural knowledge and be able to relate topics in mathematics in particular, and relate mathematics to other fields in general. This will increase pupils' understanding of mathematics and making mathematics clearer, more meaningful and interesting.

Mathematics Process Standards

The following are the process standards to be achieved by pupils through the implementation of this curriculum.

Table 1: Mathematics Process Standards

PROBLEM SOLVING

- Understand the problems.
- Extracting relevant information in a given situation and organize information systematically.
- Plan various strategies to solve problems.
- Implement the strategies in accordance to the plan.
- Generate solutions to meet the requirements of the problem.
- Interpret the solutions.
- Review and reflect upon the solutions and strategies used.

REASONING

- Recognize reasoning and proving as fundamental to mathematics.
- Recognize patterns, structures, and similarities within real-life situations and symbolic representations.
- Choose and use different types of reasoning and methods of proving.
- Create, investigate and verify mathematical conjectures.
- Develop and evaluate mathematical arguments and proofs.
- Make decisions and justify the decisions made.

COMMUNICATION IN MATHEMATICS

- Organize and incorporate mathematical thinking through communication to clarify and strengthen the understanding of mathematics.
- Communicate mathematical thoughts and ideas clearly and confidently.
- Use the language of mathematics to express mathematical ideas precisely.
- Analyze and evaluate the mathematical thinking and strategies of others.

REPRESENTATION

- Describe mathematical ideas using different types of representations.
- Make interpretation from given representations.
- Choose the appropriate type of representations.
- Use different types of mathematical representations to:

10

i) simplify complex mathematical ideas;

ii) assist in problem solving;

iii) develop models and interpret mathematical phenomena; and

iv) make connections between different types of representations.

CONNECTION

- Identify and use the connection between mathematical ideas.
- Understand how mathematical ideas are inter-related and form a cohesive unity.
- Relate mathematical ideas to daily life and other fields.

Skills

The skills that must be developed and instilled among pupils through the teaching of this subject include the mathematical skills, the 21st century skills and the higher-order thinking skills (HOTS).

The mathematical skills refer to, among others, the skills of measuring and constructing, estimating and rounding, collecting and handling data, representing and interpreting data, recognizing relationships and representing mathematically, translating real-life situation into mathematical models, using the precise language of mathematics, applying logical reasoning, using algorithms and relationship, using mathematical tools, solving problems, making decisions and so on. In addition, the curriculum also demands the development of pupils' mathematical skills related to creativity, the needs of originality in their thinking and the ability to see things around them with new and different perspective in order to develop creative and innovative individuals. The use of mathematical tools strategically, accurately and effectively is emphasized in the teaching and learning of mathematics. The mathematical tools include paper and pencils, rulers, protractors, compasses, calculators, spreadsheets, dynamic softwares and so on.

The rapid progress of various technologies in todays' life has resulted in the use of technologies as an essential element in the teaching and learning of mathematics. Effective teachers will maximize the potential and technological capabilities so that pupils can build understanding and increase their proficiency and interest in mathematics. Due to the capacity and effectiveness of technology in the teaching and learning of mathematics content, teachers need to embrace the use of technology, particularly graphing calculators, and computer softwares

like Geometer's Sketchpad, Geogebra, spreadsheets, learning softwares (courseware), the Internet and others.

However, technology must be used wisely. Calculator for example is not to be used to the extent that the importance of mental calculations and basic computations is neglected. Efficiency in carrying out the calculations is important especially in the lower level and pupils should not totally rely on calculators. For example, the graphing calculator helps pupils to visualize the nature of a function and its graph, however, using paper and pencil is still the learning outcomes to be achieved by all pupils. Similarly, in seeking the roots of the quadratic equations, the basic concept must first be mastered by the pupils. Technology should be used wisely to help pupils form concepts, enhance understanding, visualize abstract concepts and so on while enriching pupils' learning experiences.

The skills in using technology that need to be nurtured among the pupils through the teaching and learning of mathematics is the pupils' ability in:

- Using technology to explore, do research, construct mathematical modelling, hence form a deep understanding of the mathematical concepts;

- Using technology to help in calculations to solve problems effectively;

- Using technology, especially electronic and digital technology to find, manage, evaluate and communicate information; and

- Using technology responsibly and ethically.

The use of technology such as dynamic software, graphing calculator, the Internet and so on needs to be integrated into the teaching and learning of mathematics to help pupils form deep understanding of a concept especially abstract concepts.

Values in Mathematics Education

Values are affective qualities intended to be formed through the teaching and learning of mathematics using appropriate contexts. Values are usually taught and learned implicitly through the learning sessions. Good moral values develop great attitudes. The application of values and attitudes in the teaching and learning of mathematics are meant to produce individuals who are competent in terms of knowledge and skills as well as having good characters. Embracing the

12

values would produce a virtuous young generation with high personal qualities and good attitudes.

Values that need to be developed in pupils through the teaching and learning of mathematics are:

- Mathematical values - values within the knowledge of mathematics which include emphasis on the properties of the mathematical knowledge; and
- Universal values - universal noble values that are applied across all the subjects.

The development of values through teaching and learning of mathematics should also involve the elements of divinity, faith, interest, appreciation, confidence, competence and tenacity. Belief in the Greatness and Majesty of God can basically be nurtured through the content of the curriculum. The relationship between the content learned in the classroom and the real world will enable pupils to see and validate the Greatness and the power of the Creator of the universe.

The elements of history and patriotism should also be inculcated through relevant topics to enable pupils to appreciate mathematics as well as to boost interest and confidence in mathematics. Historical elements such as

events involving mathematicians or a brief history of a concept or symbol are also emphasized in this curriculum.

21st Century Skills

One of the aims of KSSM is to produce pupils who possess the skills of the 21st century by focussing on thinking skills, living skills and career, guided by the practice of good moral values.

Skills for the 21st Century aim to produce pupils who have the characteristics specified in the pupils' profile in Table 2, to enable them to compete on a global level. The mastery of the Content Standards and the Learning Standards in the Mathematics Curriculum contributes to the acquisition of the 21st century skills among the pupils.

Table 2: Pupils' Profile

PUPILS' PROFILE	DESCRIPTOR
Resilient	Pupils are able to face and overcome the difficulties and challenges with wisdom, confidence, tolerance, and empathy.

PUPILS' PROFILE	DESCRIPTOR	PUPILS' PROFILE	DESCRIPTOR
Competent communicator	Pupils are able to voice out and express their thoughts, ideas and information with confidence and creativity, verbally and in written form, using various media and technologies.		skills that are necessary for inquiry-learning and research, as well as display independent traits in learning. The pupils are able to enjoy continuous life-long learning experiences.
Thinker	Pupils are able to think critically, creatively and innovatively; solve complex problems and make ethical judgements. They are able to think about learning and about being learners themselves. They generate questions and are open towards other people's perspectives, values, individual's and other communities' traditions. They are confident and creative in handling new learning areas.	**Principled**	Pupils have a sense of integrity, sincerity, equality, fairness, high moral standards and respect for individuals, groups and the community. They are responsible for their actions, reactions and decisions.
Team Work	Pupils can co-operate effectively and harmoniously with one another. They shoulder responsibilities together as well as respect and appreciate the contributions from each member of the team. They acquire interpersonal skills through collaboration, and this makes them better leaders and team members.	**Informed**	Pupils are able to obtain knowledge and develop a broad and balanced understanding across the various disciplines of knowledge. They explore knowledge efficiently and effectively in terms of local and global contexts. They understand issues related to ethics or laws regarding information that they have acquired.
Inquisitive	Pupils are able to develop natural inquisitiveness to explore new strategies and ideas. They learn	**Caring**	Pupils are able to show empathy, compassion and respect towards the needs and feelings of others. They are committed to serving the society and ensuring the sustainability of the environment.
		Patriotic	Pupils are able to display their love, support and respect for the country.

14

HIGHER ORDER THINKING SKILLS

Higher Order Thinking Skills (HOTS) are explicitly stated in the curriculum so that teachers are able to translate into their teaching and learning to promote a structured and focused thinking among students. Explanation of HOTS focuses on four levels of thinking as shown in Table 3.

Table 3: Level of Thinking in HOTS

LEVEL OF THINKING	EXPLANATION
Creation	Produce creative and innovative ideas, products or methods.
Evaluation	Make considerations and decisions using knowledge, experience, skills, and values as well as giving justification.
Analysis	Ability to break down information into smaller parts in order to understand and make connections between these parts.
Application	Using knowledge, skills and values in different situations to perform a task.

HOTS is the ability to apply knowledge, skills and values to make reasoning and reflection to solve problems, make decisions, innovate and able to create something.

HOTS includes critical and creative thinking, reasoning and thinking strategies. Critical thinking skills is the ability to evaluate a certain idea logically and rationally in order to make a sound judgement using logical reasons and evidences.

Creative thinking skills is the ability to produce or create something new and worthy using authentic imagination and thinking out of the box.

Reasoning skills is an individual's ability to make logical and rational considerations and evaluations.

Thinking strategies is a structured and focused way of thinking to solve problems.

HOTS can be applied in classrooms through reasoning, inquiry-based learning, problem solving and projects. Teachers and pupils need to use thinking tools such as thinking maps and mind maps as well as high-level questioning techniques to encourage pupils to think.

TEACHING AND LEARNING STRATEGIES

Good teaching and learning of mathematics demands teachers to carefully plan activities and to integrate diversified strategies that enable pupils to not only understand the content in depth, but challenges them to think at a higher level.

The teaching and learning of mathematics emphasizes active pupil participation, which among others, can be achieved through:

- Inquiry-based learning, which includes investigation and exploration of mathematics;
- Problem-based learning; and
- The use of technology in concept buidling.

Inquiry-based is an approach that emphasizes learning through experience. Inquiry generally means to seek information, to question and to investigate real-life phenomena. The discovery is a major characteristic of inquiry-based learning. Learning through discovery occurs when the main concepts and principles are investigated and discovered by pupils themselves. Through the activities, pupils will investigate a phenomenon, observe patterns and thus form their own conclusions. Teachers then guide pupils to discuss and understand the concept of mathematics through the inquiry results.

Mathematics KSSM emphasizes deep conceptual understanding, efficiency in manipulation, the ability to reason and communicate mathematically. Thus the teaching and learning that involves inquiry, exploration and investigation of mathematics should be conducted wherever appropriate. Teachers need to design teaching and learning activities that provides space and opportunities for pupils to make conjectures, reason out, ask questions, make reflections and thus form concepts and acquire knowledge on their own.

A variety of opportunities and learning experiences, integrating the use of technology, and problem solving that involves a balance of both routine and non-routine questions are also emphasized in the teaching and learning of mathematics. Non-routine questions requiring higher-order thinking are emphasized in order to achieve the vision of producing human capital who can think mathematically, creatively as well as innovatively, are able to compete in the era of globalization and to meet the challenges of the 21st century.

Mathematics is a body of knowledge consisting of concepts, facts, characteristics, rules, patterns and processes. Thus, the strategies used in the teaching and learning of mathematics require diversity and balance. The traditional strategy is sometimes still necessary when teaching a procedural-based content. On the other hand, certain content requires teachers to provide learning activities that enable pupils to discover the concept on their own. Thus, structured questioning techniques are needed to enable pupils to discover the rules, patterns or the properties of mathematical concepts.

The use of teaching aids and carrying out tasks in the form of presentations or project work need to be incorporated into the learning experiences in order to develop pupils who are competent in applying knowledge and skills of mathematics in solving problems involving everyday situations as well as to develop soft skills among them. In addition, teachers need to use diversified approaches and strategies in teaching and learning such as cooperative learning, mastery learning, contextual learning, constructivism, project-based learning and so on.

Thoughtful learning of mathematics should be incorporated into the teaching and learning practices. Thus, teaching and learning strategies should be student-centred to enable them to interact and master the learning skills through their own experiences. Approaches and strategies of learning, such as inquiry-discovery, exploration and investigation of mathematics and student-centred activities with the aid of mathematical tools that are appropriate, thorough and effective can make the learning of mathematics fun, meaningful, useful and challenging which in turn will form the basis of a deep understanding of concepts.

Teachers need to diversify the methods and strategies of teaching and learning to meet the needs of pupils with various abilities, interests and preferences. The active involvement of pupils in meaningful and challenging teaching and learning activities should be designed specifically to cater to their needs. Every pupil should have an equal opportunity to form conceptual understanding and procedural competence. Therefore, teachers should be careful in providing the ecosystem of learning and intellectual discussions that require pupils to collaborate in solving meaningful and challenging assignments.

17

Creativity and innovation are key elements in the development of a knowledgable society in the 21st century. Both of these elements will significantly contribute to the social and individual prosperity of a country. Malaysia needs creative and innovative human capital in order to compete in todays' world which is increasingly competitive and dynamic. Education is seen as a means in the formation of creativity and innovation skills among the people.

Creativity and innovation are interrelated. In general, creativity refers to the ability to produce new ideas, approaches or actions. Innovation is the process of generating creative ideas in a certain context. Creativity and innovation capabilities are the skills that can be developed and nurtured among pupils through the teaching and learning in the classroom. Mathematics is the science of patterns and relationship which are closely related to the natural phenomena. Hence, mathematics is the cornerstone and the catalyst for the development of creativity and innovative skills among pupils through suitable tasks and activities.

Teachers need to design teaching and learning activities that encourage and foster creativity and innovation. Among the strategies that can be used, is to involve pupils in complex cognitive activities such as:

- The implementation of tasks involving non-routine questions requiring diversified problem-solving strategies and high level of thinking;

- The use of technology to explore, build conceptual understanding and solve problems;

- Fostering a culture in which pupils showcase creativity and innovation in a variety of forms; and

- Design teaching and learning that provide space and opportunities for pupils to do mathematics and build understanding through inquiry-based exploration and investigation activities.

CROSS-CURRICULAR ELEMENTS

Cross-curricular Elements (EMK) is a value-added elements applied in the teaching and learning process other than those specified in the Content Standard. These elements are applied to strengthen the skills and competency of the intended human capital, capable of dealing with the current and future challenges. The elements in the EMK are as follows:

18

1. **Language**

   - The use of proper language of instruction should be emphasized in all subjects.

   - During the teaching and learning of every subject, aspects of pronunciation, sentence structure, grammar, vocabulary and grammar should be emphasized to help pupils organize ideas and communicate effectively.

2. **Environmental Sustainability**

   - Developing awareness and love for the environment need to be nurtured through the teaching and learning process in all subjects.

   - Knowledge and awareness on the importance of the environment would shape pupils' attitude in appreciating nature.

3. **Good Moral Values**

   - Good moral values are emphasized in all subjects so that pupils are aware of its importance, hence practice good values.

   - Good moral values include aspects of spirituality, humanity and citizenship that are being practised in daily life.

4. **Science and Technology**

   - Increasing the interest in science and technology can improve literacy in science and technology among pupils.

   - The use of technology in teaching can help and contribute to a more efficient and effective learning.

   - Integration of science and technology in teaching and learning encompasses four main factors:
     - knowledge of science and technology (facts, principles, concepts related to science and technology);
     - scientific skills (thinking processes and certain manipulative skills);
     - scientific attitude (such as accuracy, honesty, safety); and
     - the use of technology in teaching and learning activities.

5. Patriotism

- The spirit of patriotism is to be fostered through all subjects, extra-curricular activities and community services.
- Patriotism develops the spirit of love for the country and instils a sense of pride to be Malaysians amongst pupils.

6. Creativity dan Innovation

- Creativity is the ability to use imagination to collect, assimilate and generate ideas or create something new or original by inspiration or combinations of existing ideas.
- Innovation is the application of creativity through modification, correcting and practising the ideas.
- Creativity and innovation go hand in hand and are needed in order to develop human capital that can face the challenges of the 21st century.
- Elements of creativity and innovation should be integrated into the teaching and learning.

7. Entrepreneurship

- Application of entrepreneurial elements aims to establish the characteristics and the practice of entrepreneurship so that it becomes a culture among pupils.
- Features of entrepreneurship can be applied in teaching and learning through activities that could foster attitudes such as diligence, honesty, trustworthy, responsibility and to develop creative and innovative minds to market the idea.

8. Information and Communication Technology (ICT)

- Application of ICT element into the teaching and learning is to ensure that pupils can apply and consolidate the knowledge and skills learnt.
- The application of ICT not only encourages pupils to be creative but also makes teaching and learning more interesting and fun as well as improving the quality of learning.
- ICT should be integrated in the lesson based on appropriate topics to be taught to further enhance pupils understanding of the content.

SCHOOL ASSESSMENT

School assessment is part of the assessment approaches, a process to obtain information on pupils' progress which is planned, carried out and reported by the teachers concerned. This on-going process occurs formally and informally so that teachers can determine the actual level of pupils' achievement. School assessment is to be carried out holistically based on inclusive, authentic and localised principles. Information obtained from the school assessments will be used by administrators, teachers, parents and pupils in planning follow-up actions to improve the learning development of pupils.

Teachers can carry out formative and summative assessments as school assessments. Formative assessments are carried out in line with the teaching and learning processes, while summative assessments are carried out at the end of a learning unit, term, semester or year. In carrying out the school assessments, teachers need to plan, construct items, administer, mark, record and report pupils' performance level in the subjects taught based on the Standard-based Curriculum and Assessment Documents.

The information collected through the school assessments should help teachers to determine the strengths and weaknesses of pupils in achieving a content standard. The information collected should also help teachers to adapt the teaching and learning based on the needs and weaknesses of their pupils. A comprehensive school assessment should be planned and carried out continuously as part of classroom activities. Besides helping to improve pupils' weaknesses, teachers' efforts in implementing holistic school assessment will form a balanced learning ecosystem.

In order to ensure that the school assessment helps to increase pupils' capacity and performance, teachers should use assessment strategies that have the following features:

- Taking into account the knowledge, skills and values that are intended in the curriculum;
- Various forms such as observation of activities, tests, presentations, projects, folio and so on;
- Designed to enable students to exhibit a wide range of learning abilities;
- Fair to all students; and
- Holistic, that is taking into account the various levels of cognitive, affective and psychomotor.

Assessment of Content

In general, Content Assessment is carried out topically, comprising also mathematical processes and skills. Topical assessments coupled with the integration of processes as well as mathematical skills, aims to gauge the extent of pupils' understanding of a certain content standard comprehensively and holistically. Performance Standards (SPi) for each topic is constructed based on the General Performance Level as in table 4.

Table 4: General Performance Level

PERFORMANCE LEVEL	DESCRIPTOR
1	Demonstrate basic knowledge such as stating a certain mathematical idea either verbally or non-verbally.
2	Demonstrate understanding such as explaining a certain mathematical concept either verbally or non-verbally.
3	Apply understanding such as performing calculations, constructing tables and drawing graphs.
4	Apply suitable knowledge and skills such as using algorithms, formulae, procedures or basic methods in the context of solving simple routine problems.
5	Apply suitable knowledge and skills in new situations such as performing multi-step procedures, using representations based on different sources of information and reason out directly in the context of solving complex routine problems.
6	Apply suitable knowledge and skills such as using information based on investigation and modelling in solving complex problems involving real life situations; reason out at high level, form new approaches and strategies in the context of solving non-routine problems creatively.

SPi outlines the elements to be taken into account in assessing and reporting pupils' achievement for each topic. The SPi is placed at the end of each topic to facilitate teacher.

22

Assessment of Values

Elements of attitudes and values that need to be displayed and practised by pupils are assessed continuously through various media such as observations, exercises, presentations, pupils' verbal responses, collaborative activities and so on. The achievement report of these elements can be done in mid-year and year-end to observe the progress of pupils and help them improve good value practices, based on Table 5.

Table 5: Value Assessment in Mathematics Education

VALUE IN MATHEMATICS EDUCATION		INTERNALISATION LEVEL		
		LOW	MEDIUM	HIGH
1	Interested in learning mathematics.	1 - 2	3 - 4	5 - 6
2	Appreciate the aesthetic values and the importance of mathematics.			
3	Confident and persevere in learning mathematics.			
4	Willing to learn			

VALUE IN MATHEMATICS EDUCATION		INTERNALISATION LEVEL		
		LOW	MEDIUM	HIGH
	from mistakes.			
5	Work towards accuarcy.			
6	Practise self-access learning.			
7	Dare to try something new			
8	Work systematically			
9	Use mathematical tools accurately and effectively.			

Level of value internalisation in Mathematics Education is categorised into three levels, which is low, medium and high.

Teachers need to assess these elements holistically and comprehensively through detailed observation as well as using professional judgments to determine the level of internalisation of values that should be given to each pupil. The scale in table 6 is used to label the pupils' level of internalisation as Low, Medium or High.

23

Table 6: Value Internalisation Level

LOW	1 until 3 from all the standards listed are observed
MEDIUM	4 until 6 from all the standards listed are observed
HIGH	7 until 9 from all the standards listed are observed

Reporting of Overall Performance Level

Overall reporting is required to determine pupils' achievement level at the end of a specific schooling session. This reporting comprises the aspects of content, skills and mathematical processes which are emphasized in the curriculum, including higher order thinking skills. Thus, teachers need to evaluate pupils collectively, comprehensively, holistically, taking into consideration of pupils' activities on a continuous basis through various media such as achievement in topical tests, observations, exercises, presentations, pupils' verbal responses, group work, projects and so on. Therefore, teachers have to use their wisdom in making professional judgement to determine pupils' overall performance level. In addition, various tasks

that contain elements that are emphasized in the overall performance level have to be developed in each pupil through integrated and across the learning activities. Reporting of overall performance level however does not include elements of values which have to be reported separately to facilitate the stakeholders to evaluate pupils' internalisation level in that particular aspect. Table 7 below is used to evaluate and report pupils' overall performance level.

Table 7: Overall Performance Level

PERFORMANCE LEVEL	CONTENTS, SKILLS AND MATHEMATICAL PROCESSES
1	Pupils are able to: answer questions where all related information are given and questions are defined clearly; identify information and carry out routine procedures according to clear instructions.
2	Pupils are able to: recognise and interpret situations directly; use single representation, use algorithms, formulae, procedures or basic methods; make direct reasoning; make interpretations of the results obtained.

PERFORMANCE LEVEL	CONTENTS, SKILLS AND MATHEMATICAL PROCESSES
3	Pupils are able to: perform procedures that are stated clearly, including multi-steps procedures; apply simple problem solving strategies based on different information sources; make direct reasoning; communicate briefly when making interpretations, results and reasoning.
4	Pupils are able to: use explicit models effectively in concrete complex situations, choose and integrate different representations and relate to real world situations; flexibility in using skills and reasonings based on deep understanding and communicate with explanations and arguments based on interpretations, discussions and actions.
5	Pupils are able to: develop and use models for complex situations; identify constraints and make specific assumptions; apply suitable problem-solving strategies; work strategically using in-depth thinking skills and reasoning; use various suitable representations and display in-depth understanding; reflect on results and actions; conclude and communicate with explanations and arguments based on interpretations, discussions and

PERFORMANCE LEVEL	CONTENTS, SKILLS AND MATHEMATICAL PROCESSES
	actions.
6	Pupils are able to: conceptualise, make generalisations and use information based on investigations and modelling of complex situations; relate information sources and flexibly change one form of representations to another; possess high level mathematical thinking and reasoning skills at; demonstrate in-depth understanding; form new approaches and strategies to handle new situations; conclude and communicate with explanations and arguments based on interpretations, discussions and actions.

Based on the Overall Performance level, it is clear that teachers should use tasks with various levels of difficulty and complexity which are able to access various elements and pupils' mastery level. Holistic assessment is needed in developing pupils with global skills. Content mastery has to be supported by pupils' ability to achieve and apply processes, hence display the ability in solving complex problems especially those involving real-world situations. It is important that teachers carry out comprehensive

assessments and report fair and just performance level of each pupil.

CONTENT ORGANISATION

Mathematics KSSM consists of three important components: Content Standards, Learning Standards and Performance Standards.

Content Standard (SK) is a specific statement on what pupils should know and be able to do in a certain schooling duration which encompasses the aspects of knowledge, skills and values.

Learning Standard (SP) is criterion set or indicators of the quality of learning and achievement that can be measured for each content standard.

Performance Standard (SPi) is a set of general criterion that shows the level of performance that pupils should display as an indicator that they have mastered a certain matter.

There is also a **Notes** column details out the:

- Limitations and scope of the Content Standard and Learning Standards;
- Suggested teaching and learning activities; and
- Information or notes related to teaching and learning of mathematics that supports teachers' understanding.

In preparing the activities and learning environments that are suitable and relevant to the abilities and interests of pupils, teachers need to use creativity and their profesional discretion. The list of activities suggested is not absolute.

Teachers are advised to use various resources such as books and the Internet in preparing teaching and learning activities suitable to the abilities and interests of their pupils.

LEARNING AREA
NUMBERS AND OPERATIONS

TITLE
1.   RATIONAL NUMBERS

1.   RATIONAL NUMBERS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
1.1 Integers	1.1.1 Recognise positive and negative numbers based on real-life situations.	Relate to real-life situations such as left and right, up and down movement.
	1.1.2 Recognise and describe integers.	
	1.1.3 Represent integers on number lines and make connections between the values and positions of the integers with respect to other integers on the number line.	
	1.1.4 Compare and arrange integers in order.	
1.2 Basic arithmetic operations involving integers	1.2.1 Add and subtract integers using number lines or other appropriate methods. Hence, make generalisation about addition and subtraction of integers.	Other methods such as concrete materials (coloured chips), virtual manipulative materials and GSP software.
	1.2.2 Multiply and divide integers using various methods. Hence make generalisation about multiplication and division of integers.	
	1.2.3 Perform computations involving combined basic arithmetic operations of integers by following the order of operations.	
	1.2.4 Describe the laws of arithmetic operations which are Identity Law, Communicative Law, Associative Law and Distributive Law.	Carry out exploratory activities.

1.   RATIONAL NUMBERS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	1.2.5 Perform efficient computations using the laws of basic arithmetic operations.	Example of an efficient computation involving Distributive Law: $2030 \times 25 = (2000 + 30) \times 25$ $= 50\ 000 + 750$ $= 50\ 750$ Efficient computations may differ among pupils.
	1.2.6 Solve problems involving integers.	
1.3 Positive and negative fractions	1.3.1 Represent positive and negative fractions on number lines. 1.3.2 Compare and arrange positive and negative fractions in order. 1.3.3 Perform computations involving combined basic arithmetic operations of positive and negative fractions by following the order of operations. 1.3.4 Solve problems involving positive and negative fractions.	
1.4 Positive and negative decimals	1.4.1 Represent positive and negative decimals on number lines. 1.4.2 Compare and arrange positive and negative decimals in order.	

1.   RATIONAL NUMBERS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	1.4.3 Perform computations involving combined basic arithmetic operations of positive and negative decimals by following the order of operations. 1.4.4 Solve problems involving positive and negative decimals.	
1.5 Rational numbers	1.5.1 Recognise and describe rational numbers. 1.5.2 Perform computations involving combined basic arithmetic operations of rational numbers by following the order of operations. 1.5.3 Solve problems involving rational numbers.	Rational numbers are numbers that can be written in fractional form, that is $\dfrac{p}{q}$, p and q are integers, $q \neq 0$.

1.   RATIONAL NUMBERS

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of integers, fractions and decimals.
2	Demonstrate the understanding of rational numbers.
3	Apply the understanding of rational numbers to perform basic operations and combined basic arithmetic operations.
4	Apply appropriate knowledge and skills of rational numbers in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of rational numbers in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of rational numbers in the context of non-routine problem solving.

LEARNING AREA
NUMBERS AND OPERATIONS

TITLE
2. FACTORS AND MULTIPLES

2.   FACTORS AND MULTIPLES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
2.1 Factors, prime factors and Highest Common Factor (HCF)	2.1.1 Determine and list the factors of whole numbers, and hence make generalisation about factors. 2.1.2 Determine and list the prime factors of a whole number, and hence express the number in the form of prime factorisation. 2.1.3 Explain and determine the common factors of whole numbers. 2.1.4 Determine the HCF of two and three whole numbers. 2.1.5 Solve problems involving HCF.	Also consider cases involving more than three whole numbers. Use various methods including repeated division and the use of prime factorisation.
2.2 Multiples, common multiples and Lowest Common Multiple (LCM)	2.2.1 Explain and determine the common multiples of whole numbers. 2.2.2 Determine the LCM of two and three whole numbers. 2.2.3 Solve problems involving LCM.	Also consider cases involving more than three whole numbers. Use various methods including repeated division and the use of prime factorisation.

2. FACTORS AND MULTIPLES

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of prime numbers, factors and multiples.
2	Demonstrate the understanding of prime numbers, factors and multiples.
3	Apply the understanding of prime numbers, factors and multiples to perform simple tasks involving HCF and LCM.
4	Apply appropriate knowledge and skills of prime numbers, factors and multiples in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of prime numbers, factors and multiples in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of prime numbers, factors and multiples in the context of non-routine problem solving.

LEARNING AREA
NUMBERS AND OPERATIONS

TITLE
3.   SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

3.   SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
3.1 Squares and square roots	3.1.1 Explain the meaning of squares and perfect squares.	Explore the formation of squares using various methods including the use of concrete materials.
	3.1.2 Determine whether a number is a perfect square.	Perfect squares are 1, 4, 9, ...
	3.1.3 State the relationship between squares and square roots.	Relationship is stated based on the outcome of exploration.
		Square roots of a number are in positive and negative values.
	3.1.4 Determine the square of a number with and without using technological tools.	
	3.1.5 Determine the square roots of a number without using technological tools.	Limit to: a) perfect squares b) fractions when the numerators and denominators are perfect squares c) fractions that can be simplified such that the numerators and denominators are perfect squares d) decimals that can be written in the form of the squares of other decimals.

3.   SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	3.1.6 Determine the square roots of a positive number using technological tools.	
	3.1.7 Estimate (i) the square of a number, (ii) the square roots of a number.	Discuss the ways to improve the estimation until the best estimation is obtained; whether in the form of a range, a whole number or to a stated accuracy.
	3.1.8 Make generalisation about multiplication involving: (i) square roots of the same numbers, (ii) square roots of different numbers.	Generalisations are made based on the outcome of explorations.
	3.1.9 Pose and solve problems involving squares and square roots.	
3.2 Cubes and cube roots	3.2.1 Explain the meaning of cubes and perfect cubes.	Explore the formation of cubes using various methods including the use of concrete materials.
	3.2.2 Determine whether a number is a perfect cube.	Perfect cubes are 1, 8, 27, ...
	3.2.3 State the relationship between cubes and cube roots.	Relationship is stated based on the outcome of exploration.

3.   SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	3.2.4 Determine the cube of a number with and without using technological tools.	
	3.2.5 Determine the cube root of a number without using technological tools.	Limit to: a) fractions when the numerators and denominators are perfect cubes. b) fractions that can be simplified such that the numerators and denominators are perfect cubes. c) decimals that can be written in the form of the cubes of other decimals.
	3.2.6 Determine the cube root of a number using technological tools.	
	3.2.7 Estimate (i) the cube of a number, (ii) the cube root of a number.	Discuss the ways to improve the estimation until the best estimation is obtained; whether in the form of a range, a whole number or to a stated accuracy.
	3.2.8 Solve problems involving cubes and cube roots.	
	3.2.9 Perform computations involving addition, subtraction, multiplication, division and the combination of these operations on squares, square roots, cubes and cube roots.	

3.   SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	DESCRIPTOR
1	Demonstrate the basic knowledge of squares, square roots, cubes and cube roots.
2	Demonstrate the understanding of squares, square roots, cubes and cube roots.
3	Apply the understanding of squares, square roots, cubes and cube roots to perform basic operations and the combinations of basic arithmetic operations.
4	Apply appropriate knowledge and skills of squares, square roots, cubes and cube roots in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of squares, square roots, cubes and cube roots in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of squares, square roots, cubes and cube roots in the context of non-routine problem solving.

LEARNING AREA

RELATIONSHIP AND ALGEBRA

TITLE

4. RATIOS, RATES AND PROPORTIONS

4.   RATIOS, RATES AND PROPORTIONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
4.1 Ratios	4.1.1 Represent the relation between three quantities in the form of $a : b : c$.	
	4.1.2 Identify and determine the equivalent ratios in numerical, geometrical or daily situation contexts.	Examples of equivalent ratios in geometrical context: 1 : 2 2 : 4
	4.1.3 Express ratios of two and three quantities in simplest form.	Including those involving fractions and decimals.
4.2 Rates	4.2.1 Determine the relationship between ratios and rates.	Carry out exploratory activities. Involve various situations such as speed, acceleration, pressure and density. Involve conversion of units. Rate is a special case of ratio that involves two measurements of different units.
4.3 Proportions	4.3.1 Determine the relationship between ratios and proportions.	Carry out exploratory activities. Involve real-life situations.
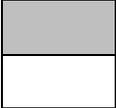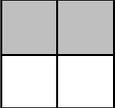
4. RATIOS, RATES AND PROPORTIONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	4.3.2 Determine an unknown value in a proportion.	Use various methods including cross multiplication and unitary method.
4.4 Ratios, rates and proportions.	4.4.1 Determine the ratio of three quantities, given two or more ratios of two quantities.	Involve real-life situations.
	4.4.2 Determine the ratio or the related value given (i) the ratio of two quantities and the value of one quantity. (ii) the ratio of three quantities and the value of one quantity.	
	4.4.3 Determine the value related to a rate.	
	4.4.4 Solve problems involving ratios, rates and proportions, including making estimations.	
4.5 Relationship between ratios, rates and proportions with percentages, fractions and decimals	4.5.1 Determine the relationship between percentages and ratios.	Carry out exploratory activities.
	4.5.2 Determine the percentage of a quantity by applying the concept of proportions.	Involve various situations.
	4.5.3 Solve problems involving relationship between ratios, rates and proportions with percentages, fractions and decimals.	

4.   RATIO, RATES AND PROPORTION

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of ratios, rates and proportions.
2	Demonstrate the understanding of ratios, rates and proportions.
3	Apply the understanding of ratios, rates and proportions to perform simple tasks.
4	Apply appropriate knowledge and skills of ratios, rates and proportions in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of ratios, rates and proportions in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of ratios, rates and proportions in the context of non-routine problem solving.

LEARNING AREA

RELATIONSHIP AND ALGEBRA

TITLE

5. ALGEBRAIC EXPRESSIONS

5.   ALGEBRAIC EXPRESSIONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
5.1 Variables and algebraic expressions	5.1.1 Use letters to represent quantities with unknown values. Hence, state whether the value of the variable varies or fixed, with justification.	Letters as variables. Involve real-life situations.
	5.1.2 Derive algebraic expressions based on arithmetic expressions that represent a situation.	
	5.1.3 Determine the values of algebraic expressions given the values of variables and make connection with appropriate situations.	
	5.1.4 Identify the terms in an algebraic expression. Hence, state the possible coefficients for the algebraic terms.	
	5.1.5 Identify like and unlike terms.	
5.2 Algebraic expressions involving basic arithmetic operations	5.2.1 Add and subtract two or more algebraic expressions.	
	5.2.2 Make generalisation about repeated multiplication of algebraic expressions.	Correlate repeated multiplication with the power of two or more.
	5.2.3 Multiply and divide algebraic expressions with one term.	

5. ALGEBRAIC EXPRESSIONS

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of variables and algebraic expressions.
2	Demonstrate the understanding of variables and algebraic expressions. .
3	Apply the understanding of algebraic expressions to perform simple tasks.

LEARNING AREA
RELATIONSHIP AND ALGEBRA

TITLE
6.   LINEAR EQUATIONS

6.   LINEAR EQUATIONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
6.1 Linear equations in one variable	6.1.1 Identify linear equations in one variable and describe the characteristics of the equations.	Carry out exploratory activities involving algebraic expressions and algebraic equations.
	6.1.2 Form linear equations in one variable based on a statement or a situation, and vice-versa.	
	6.1.3 Solve linear equations in one variable.	Use various methods such as trial and improvement, backtracking, and applying the understanding of equality concept.
	6.1.4 Solve problems involving linear equations in one variable.	
6.2 Linear equations in two variables	6.2.1 Identify linear equations in two variables and describe the characteristics of the equations.	State the general form of linear equations in two variables, which is $ax + by = c$.
	6.2.2 Form linear equations in two variables based on a statement or a situation, and vice-versa.	
	6.2.3 Determine and explain possible solutions of linear equations in two variables.	

6.   LINEAR EQUATIONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	6.2.4 Represent graphically the linear equations in two variables.	Including cases of (x, y) when (i) x is fixed and y varies, (ii) x varies and y is fixed. Involve all quadrants of the Cartesian system.
6.3 Simultaneous linear equations in two variables	6.3.1 Form simultaneous linear equations based on daily situations. Hence, represent graphically the simultaneous linear equations in two variables and explain the meaning of simultaneous linear equations. 6.3.2 Solve simultaneous linear equations in two variables using various methods. 6.3.3 Solve problems involving simultaneous linear equations in two variables.	Use software to explore cases involving lines that are: (i) Intersecting (unique solution) (ii) Parallel (no solution) (iii) Overlapping (infinite solutions) Involve graphical and algebraic methods (substitution, elimination) Use technological tools to explore and check the answers.

6. LINEAR EQUATIONS

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of linear equations.
2	Demonstrate the understanding of linear equations and simultaneous linear equations.
3	Apply the understanding of the solution for linear equations and simultaneous linear equations.
4	Apply appropriate knowledge and skills of linear equations and simultaneous linear equations in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of linear equations and simultaneous linear equations in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of linear equations and simultaneous linear equations in the context of non-routine problem solving.

LEARNING AREA
RELATIONSHIP AND ALGEBRA

TITLE
7.   LINEAR INEQUALITIES

7.   LINEAR INEQUALITIES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
7.1 Inequalities	7.1.1 Compare the values of numbers, describe inequality and hence, form algebraic inequality.	Use number lines to represent inequality relations, '>', '<', '≥' and '≤'. Involve negative numbers.
	7.1.2 Make generalisation about inequality related to (i) the converse and transitive properties, additive and multiplicative inverse, (ii) basic arithmetic operations.	Carry out exploratory activities. Converse property → if $a < b$, then $b > a$. Transitive property → if $a < b < c$, then $a < c$. Additive inverse → if $a < b$, then $-a > -b$. Multiplicative inverse → if $a < b$, then $\frac{1}{a} > \frac{1}{b}$. Basic arithmetic operations: when additions, subtractions, multiplications or divisions performed on both sides.
7.2 Linear inequalities in one variable	7.2.1 Form linear inequalities based on daily life situations, and vice-versa.	
	7.2.2 Solve problems involving linear inequalities in one variable.	Number lines can be used to solve problems.
	7.2.3 Solve simultaneous linear inequalities in one variable.	

7.   LINEAR INEQUALITIES

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of linear inequalities in one variable.
2	Demonstrate the understanding of linear inequalities in one variable.
3	Apply the understanding of linear inequalities in one variable to perform simple tasks.
4	Apply appropriate knowledge and skills of linear inequalities in one variable in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of linear inequalities in one variable in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of linear inequalities in one variable in the context of non-routine problem solving.

LEARNING AREA
MEASUREMENT AND GEOMETRY

TITLE
8.   LINES AND ANGLES

8.   LINES AND ANGLES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
8.1 Lines and angles	8.1.1 Determine and explain the congruency of line segments and angles.	
	8.1.2 Estimate and measure the size of line segments and angles, and explain how the estimation is obtained.	
	8.1.3 Recognise, compare and explain the properties of angles on a straight line, reflex angles, and one whole turn angles.	
	8.1.4 Describe the properties of complementary angles, supplementary angles and conjugate angles.	Carry out exploratory activities.
	8.1.5 Solve problems involving complementary angles, supplementary angles and conjugate angles.	
	8.1.6 Construct (i) line segments, (ii) perpendicular bisectors of line segments, (iii) perpendicular line to a straight line, (iv) parallel lines and explain the rationale of construction steps.	Use a) compasses and straight edge tool only, b) any geometrical tools, c) geometry software for constructions.
	8.1.7 Construct angles and angle bisectors, and explain the rationale of construction steps.	Use the angle of 60° as the first example for construction using compasses and straightedge tool only.

8.   LINES AND ANGLES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
8.2 Angles related to intersecting lines	8.2.1 Identify, explain and draw vertically opposite angles and adjacent angles at intersecting lines, including perpendicular lines. 8.2.2 Determine the values of angles related to intersecting lines, given the values of other angles. 8.2.3 Solve problems involving angles related to intersecting lines.	
8.3 Angles related to parallel lines and transversals	8.3.1 Recognise, explain and draw parallel lines and transversals. 8.3.2 Recognise, explain and draw corresponding angles, alternate angles and interior angles. 8.3.3 Determine whether two straight lines are parallel based on the properties of angles related to transversals. 8.3.4 Determine the values of angles related to parallel lines and transversals, given the values of other angles. 8.3.5 Recognise and represent angles of elevation and angles of depression in real-life situations. 8.3.6 Solve problems involving angles related to parallel lines and transversals.	Include angles of elevation and angles of depression.

8.   LINES AND ANGLES

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of lines and angles.
2	Demonstrate the understanding of lines and angles.
3	Apply the understanding of lines and angles to perform simple tasks.
4	Apply appropriate knowledge and skills of lines and angles in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of lines and angles in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of lines and angles in the context of non-routine problem solving.

LEARNING AREA
MEASUREMENT AND GEOMETRY

TITLE
9.   BASIC POLYGONS

9.   BASIC POLYGONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
9.1 Polygons	9.1.1 State the relationship between the number of sides, vertices and diagonals of polygons. 9.1.2 Draw polygons, label vertices of polygons and name the polygons based on the labeled vertices.	Carry out exploratory activities.
9.2 Properties of triangles and the interior and exterior angles of triangles	9.2.1 Recognise and list geometric properties of various types of triangles. Hence classify triangles based on geometric properties. 9.2.2 Make and verify conjectures about (i) the sum of interior angles, (ii) the sum of interior angle and adjacent exterior angle, (iii) the relation between exterior angle and the sum of the opposite interior angles of a triangle. 9.2.3 Solve problems involving triangles.	Geometric properties include the number of axes of symmetry. Involve various methods of exploration such as the use of dynamic software. Use various methods including the use of dynamic software.
9.3 Properties of quadrilaterals and the interior and exterior angles of quadrilaterals	9.3.1 Describe the geometric properties of various types of quadrilaterals. Hence classify quadrilaterals based on the geometric properties.	Geometric properties include the number of axes of symmetry. Involve various exploratory methods such as the use of dynamic software.

9.   BASIC POLYGONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	9.3.2 Make and verify the conjectures about 　(i)　the sum of interior angles of a quadrilateral, 　(ii)　the sum of interior angle and adjacent exterior angle of a quadrilateral, and 　(iii)　the relationship between the opposite angles in a parallelogram. 9.3.3 Solve problems involving quadrilaterals. 9.3.4 Solve problems involving the combinations of triangles and quadrilaterals.	Use various methods including the use of dynamic software.

9.   BASIC POLYGONS

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	DESCRIPTOR
1	Demonstrate the basic knowledge of polygons.
2	Demonstrate the understanding of triangles and quadrilaterals.
3	Apply the understanding of lines and angles to perform simple tasks related to the interior and exterior angles of triangles and quadrilaterals.
4	Apply appropriate knowledge and skills of triangles and quadrilaterals in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of triangles and quadrilaterals in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of triangles and quadrilaterals in the context of non-routine problem solving.

LEARNING AREA
MEASUREMENT AND GEOMETRY

TITLE
10. PERIMETER AND AREA

10.   PERIMETER AND AREA

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
10.1 Perimeter	10.1.1 Determine the perimeter of various shapes when the side lengths are given or need to be measured. 10.1.2 Estimate the perimeter of various shapes, and then evaluate the accuracy of estimation by comparing with the measured value. 10.1.3 Solve problems involving perimeter.	Various shapes including those involving straight lines and curves.
10.2 Area of triangles, parallelograms, kites and trapeziums	10.2.1 Estimate the area of various shapes using various methods. 10.2.2 Derive the formulae of the area of triangles, parallelograms, kites and trapeziums based on the area of rectangles. 10.2.3 Solve problems involving areas of triangles, parallelograms, kites, trapeziums and the combinations of these shapes.	Including the use of 1 unit × 1 unit grid paper. Carry out exploratory activities involving concrete materials or the use of dynamic software
10.3 Relationship between perimeter and area	10.3.1 Make and verify the conjecture about the relationship between perimeter and area. 10.3.2 Solve problems involving perimeter and area of triangles, rectangles, squares, parallelograms, kites, trapeziums and the combinations of these shapes.	

10. PERIMETER AND AREA

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	DESCRIPTOR
1	Demonstrate the basic knowledge of perimeter.
2	Demonstrate the understanding of perimeter and areas.
3	Apply the understanding of perimeter and areas to perform simple tasks.
4	Apply appropriate knowledge and skills of perimeter and areas in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of perimeter and areas in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of perimeter and areas in the context of non-routine problem solving.

LEARNING AREA
DISCRETE MATHEMATICS

TITLE
11. INTRODUCTION TO SET

11. INTRODUCTION TO SET

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
11.1 Set	11.1.1 Explain the meaning of set.	Carry out sorting and classifying activities including those involving real-life situations.
	11.1.2 Describe sets using: (i) description, (ii) listing, and (iii) set builder notation.	Including empty set and its symbols, { } and $\varnothing$. Involve the use of set notation. Example of set builder notation: A = {x: $x \le 10$, x is even number}
	11.1.3 Identify whether an object is an element of a set and represent the relation using symbol.	Introduce the symbols $\in$ and $\notin$.
	11.1.4 Determine the number of elements of a set and represent the number of elements using symbol.	Introduce the symbol $n(A)$.
	11.1.5 Compare and explain whether two or more sets are equal and hence, make generalisation about the equality of sets.	
11.2 Venn diagrams, universal sets, complement of a set and	11.2.1 Identify and describe universal sets and complement of a set.	Introduce the symbols for universal set (ξ), complement of a set (A') and subset ($\subset$).

11.   INTRODUCTION TO SET

CONTENT STANDARDS	LEARNING STANDARDS	NOTES

subsets	11.2.2 Represent
	  (i) the relation of a set and universal set, and
	  (ii) complement of a set
	  through Venn diagrams.
	
	11.2.3 Identify and describe the possible subsets of a set.
	
	11.2.4 Represent subsets using Venn diagrams.
	
	11.2.5 Represent the relations between sets, subsets, universal sets and complement of a set using Venn diagrams.	

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	DESCRIPTOR
1	Demonstrate the basic knowledge of sets.
2	Demonstrate the understanding of sets.
3	Apply the understanding of sets.

LEARNING AREA
STATISTICS AND PROBABILITY

TITLE
12. DATA HANDLING

12. DATA HANDLING

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
12.1 Data collection, organization and representation process, and interpretation of data representation	12.1.1 Generate statistical questions and collect relevant data.	Use statistical inquiry approach for this topic. Statistical Inquiry 1. Posing / formulating real life problems 2. Planning and collecting data 3. Organising data 4. Displaying / representing data 5. Analysing data 6. Interpretation and conclusion 7. Communicating results Statistical questions : questions that can be answered by collecting data and where there will be variability in that data. Involve real life situations. Collect data using various methods such as interview, survey, experiment and observation.
	12.1.2 Classify data as categorical or numerical and construct frequency tables.	Numerical data : discrete or continuous

12. DATA HANDLING

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	12.1.3 Construct data representation for ungrouped data and justify the appropriateness of a data representation.	Data representation including various types of bar charts, pie chart, line graph, dot plot and stem-and-leaf plot. Use various methods to construct data representations including the use of software.
	12.1.4 Convert a data representation to other suitable data representations with justification.	
	12.1.5 Interpret various data representations including making inferences or predictions.	Involve histograms and frequency polygons.
	12.1.6 Discuss the importance of representing data ethically in order to avoid confusion.	

12. DATA HANDLING

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of collecting, organizing and representing data.
2	Demonstrate the understanding of collecting, organizing and representing data.
3	Apply the understanding of data representations to construct data representations.
4	Apply appropriate knowledge and skills of data representation and data interpretation in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of data representation and data interpretation in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of data representation and data interpretation in the context of non-routine problem solving.

LEARNING AREA
MEASUREMENT AND GEOMETRY

TITLE
13. THE PYTHAGORAS THEOREM

13. THE PYTHAGORAS THEOREM

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
13.1 The Pythagoras Theorem	13.1.1 Identify and define the hypotenuse of a right-angled triangle.	
	13.1.2 Determine the relationship between the sides of right-angled triangle. Hence, explain the Pythagoras Theorem by referring to the relationship.	Carry out exploratory activities by involving various methods including the use of dynamic software.
	13.1.3 Determine the length of the unknown side of (i) a right-angled triangle. (ii) combined geometric shapes.	Determine the length of sides by applying the Pythagoras Theorem.
	13.1.4 Solve problems involving the Pythagoras Theorem.	
13.2 The converse of Pythagoras Theorem	13.2.1 Determine whether a triangle is a right-angled triangle and give justification based on the converse of the Pythagoras Theorem.	
	13.2.2 Solve problems involving the converse of the Pythagoras Theorem.	

13. THE PYTHAGORAS THEOREM

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of right-angled triangles.
2	Demonstrate the understanding of the relation between the sides of right-angled triangles.
3	Apply the understanding of the Pythagoras Theorem.
4	Apply appropriate knowledge and skills of the Pythagoras Theorem in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of the Pythagoras Theorem in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of the Pythagoras Theorem in the context of non-routine problem solving.

Bahagian Pembangunan Kurikulum
Kementerian Pendidikan Malaysia
Aras 4 - 8 Blok E9, Kompleks Kerajaan Parcel E
62604 Putrajaya
Tel: 03-8884 2000 Fax: 03-8888 9917
http://www.moe.gov.my/bpk