KEMENTERIAN PENDIDIKAN MALAYSIA

KURIKULUM STANDARD SEKOLAH MENENGAH

Matematik

Dokumen Standard Kurikulum dan Pentaksiran

Tingkatan 2

(EDISI BAHASA INGGERIS)

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(Edisi Bahasa Inggeris)

Bahagian Pembangunan Kurikulum

April 2016

Terbitan 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) 1997
[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 mengenal pasti 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 (PdP) 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.

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Pengarah
Bahagian Pembangunan Kurikulum

INTRODUCTION

Mathematics KSSM is a core subject that must be learnt by all pupils under the National Education System. In Malaysia, each pupil gets the opportunity to go through at least six years of basic education in primary school and five years in secondary school. Mathematics programme at the secondary school level is divided into three programmes: Mathematics at lower secondary, Mathematics at upper secondary and Additional Mathematics at upper secondary.

The secondary school Mathematics content is essentially a continuation of 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 the 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 Number and Operations; Measurement and Geometry; Relationship and Algebra; Statistics and Probability, and Discrete Mathematics.

2. Develop capacity for:
    - 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 judgments 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 solving problems.

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 further 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 capital who appreciate values based on spiritual practices, knowledge, personal competence, critical and creative thinking as well as innovative thinking as shown in Figure 1. The Mathematics curriculum is developed based on the six strands of the KSSM Framework.

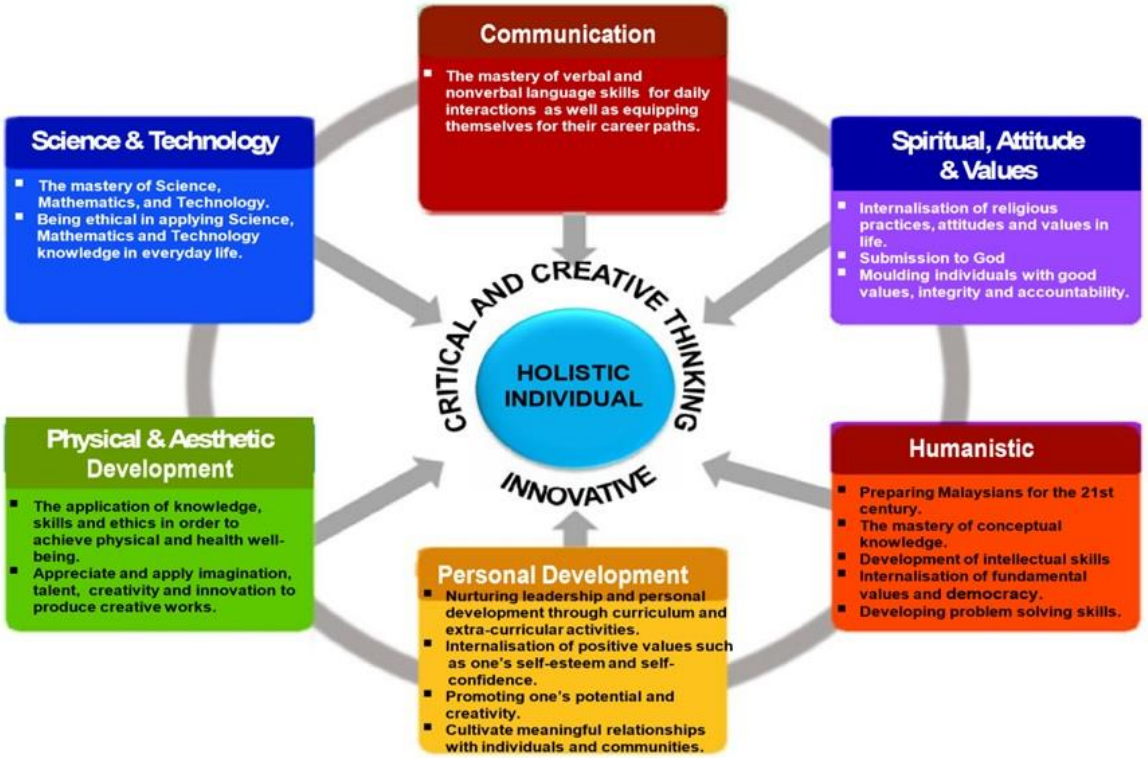

Figure 1: The Framework of Secondary School Standard-Based Curriculum

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

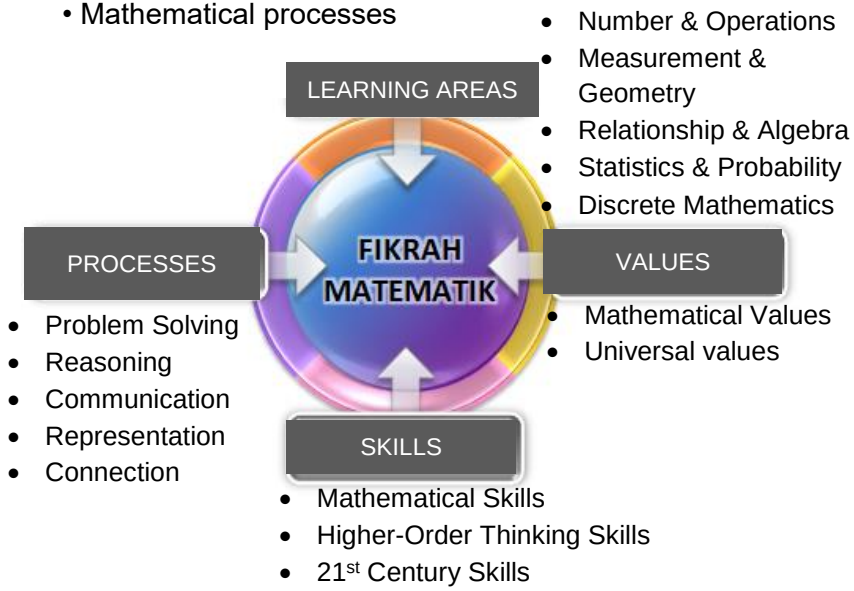

Figure 2: The Mathematics Curriculum Framework for Secondary Schools

Mathematical *Fikrah*

In the Fourth Edition of Kamus Dewan (2005), *fikrah* has the same meaning as the power of thinking and thought. 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 aims 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

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

- Number and Operations;
- Measurement and Geometry;

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

Mathematical Processes

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 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 discussion. Activities carried out should engage the pupils actively by posing a diversity of questions and tasks that contain not only the routine 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 consistently cultivated by the teachers to produce pupils who are able to compete at a global level.

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

- Understanding and interpreting problems;
- Devising a strategy;
- 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 lists;

using algebra, trying simpler cases, reason out logically, using trial and improvement, making simulation, working backwards as well as using analogies.

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

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

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

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 not only develops the capacity of logical thinking but also increases the capacity of critical thinking that is fundamental in understanding mathematics in depth and meaningfully. Therefore, teachers need to provide space and opportunity through designing teaching and learning activities that require pupils to do mathematics and be actively involved in discussing mathematical ideas.

The elements of reasoning in the teaching and learning 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 not only changes the paradigm of pupils' conscious procedural knowledge but also gives thought and intellectual empowerment when pupils are guided and trained to make and validate conjectures, 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 in mathematics is the process of expressing ideas and understanding in verbal, visual or written form using numbers, notations, symbols, diagrams, graphs, pictures or words. Communication is an important process in learning mathematics because mathematical communication helps pupils to clarify and reinforce their understanding of mathematics. Through communication, mathematical ideas can be better expressed and understood. Communication in mathematics, whether verbally, in written form or using symbols and visual representations (charts, graphs, diagrams, etc), help pupils to understand and apply mathematics more effectively.

Teachers should be aware of the opportunities that exist during teaching and learning sessions to encourage pupils to express and present their mathematical ideas by using appropriate questioning techniques. Communication that involves a variety of perspectives and points of view helps pupils to better improve their mathematical understanding whilst enhancing their 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 mathematical ideas can be explained precisely.

Effective communication requires an environment that is always sensitive to the needs of pupils so that they feel comfortable while speaking, asking and answering questions, explaining and justifying their views and statements to their 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 giving explanation to the whole class.

Representation is an important component of mathematics and often used to represent real-world phenomena. Therefore, there must be a similarity between the aspects of the world that is being represented and the world that it is representing. Representation can be defined as any notations, letters, images or concrete objects that symbolise or represent something else.

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; recognise 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 will be flexible in their thinking and understand that there are a variety of ways to represent mathematical ideas that enable problems to be solved more easily.

Connection between areas in mathematics such as counting, geometry, algebra, measurement and statistics is important for pupils to learn concepts and skills integratedly and meaningfully. 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 and connected to each other thus allowing abstract concepts to be understood easily.

When mathematical ideas are connected to daily life experiences within and outside the schools, pupils will be more aware of the use, the importance, the strength and the beauty of mathematics. Besides, they are also able to use mathematics contextually in other disciplines and in their daily lives. Mathematical models are used to describe real-life situations mathematically. Pupils will realise that this method can be used to solve problems or to predict the likelihood of a situation based on the mathematical model.

In implementing the Mathematics Curriculum, the opportunity to make connections should be established so that pupils can relate conceptual knowledge to 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; making it 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. • Extract relevant information in a given situation and organise information systematically. • Plan various strategies to solve problems. • Implement the strategies according 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
• Recognise reasoning and proving as fundamentals to mathematics. • Recognise patterns, structures, and similarities within real-life situations and symbolic representations. • Choose and use various types of reasoning and methods of proving. • Make, investigate and verify mathematical conjectures. • Develop and evaluate mathematical arguments and proofs. • Make decisions and justify the decisions made.
COMMUNICATION IN MATHEMATICS
• Organise 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. • Analyse and evaluate the mathematical thinking and strategies of others.
REPRESENTATION
• Illustrate mathematical ideas using various types of representations. • Make interpretations from given representations. • Choose the appropriate types of representations. • Use various types of mathematical representations to: i) simplify complex mathematical ideas; ii) assist in problem solving; iii) develop models and interpret mathematical phenomena; and iv) make connections between various 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 in pupils through the teaching of this subject include the Mathematical Skills, 21st Century Skills and 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, recognising relationships and representing mathematically, translating real-life situations into mathematical models, using the precise language of mathematics, applying logical reasoning, using algorithms and relationships, using mathematical tools, solving problems, making decisions and so on. In addition, the curriculum also demands the development of pupils' mathematical skills in aspects related to creativity, the needs for originality in their thinking and the ability to see things around them with new and different perspectives in order to develop creative and innovative individuals. The use of mathematical tools strategically, accurately and effectively is strongly emphasised in the teaching and learning of mathematics. The mathematical tools include papers and pencils, rulers, protractors, compasses, calculators, electronic 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 maximise 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, computer softwares like Geometer's Sketchpad, Geogebra, electronic spreadsheets, learning softwares (courseware), the Internet and others.

However, technology must be used wisely. Scientific 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, although the graphing calculator helps pupils to visualize the nature of a function and its graph, fundamentally the use of paper and

pencil is still the learning outcome 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 concepts and so on while enriching pupils' learning experiences.

Specifically, the skills in using technology that need to be nurtured among the pupils through the teaching and learning of Mathematics are the pupils' ability in:

- Using technology to explore, carry out research, construct mathematical modelling, and 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 concepts 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 good moral values would produce a virtuous young generation with noble 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 Power and Greatness of God can basically be nurtured through the content of the curriculum. The relationship between the content learned and the real world enables 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 certain events involving mathematicians or a brief history of a concept or symbol are also emphasised 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.

21st Century Skills aim to produce pupils who have the characteristics specified in the pupils' profile as in Table 2, so that they are able to compete at 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	DESCRIPTION
Resilient	Pupils are able to face and over come difficulties and challenges with wisdom, confidence, tolerance, and empathy.
Competent Communicator	Pupils voice out and express their thoughts, ideas and information confidently and creatively, in verbal and in written form, using various media and technology.
Thinker	Pupils think critically, creatively and innovatively; are able to solve complex problems and make ethical decisions. They think about learning and themselves as learners. They generate questions and be open towards other individual's and communities' perspectives, values, and traditions. They are confident

PUPILS' PROFILE	DESCRIPTION
	and creative in handling new learning areas.
Team Work	Pupils can co-operate effectively and harmoniously with others. They shoulder responsibilities together as well as respect and appreciate the contributions from each member of the team. They acquire interpersonal skills through collaborative activities, and this makes them better leaders and team members.
Inquisitive	Pupils develop natural inquisitiveness to explore new strategies and ideas. They learn skills that are necessary for inquiry-learning and research, as well as display independent traits in learning. The pupils continuously enjoy life-long learning experiences.
Principled	Pupils have a sense of integrity and sincerity, equality, fairness and respect the dignity of individuals, groups and community. They are responsible for their actions, consequences and decisions.
Informed	Pupils 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 acquired.
Caring	Pupils show empathy, compassion and respect towards the needs and feelings of others. They are committed to serve the society and ensure the sustainability of the environment.
Patriotic	Pupils demonstrate their love, support and respect for the country.

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
Creating	Producing creative and innovative ideas, products or methods.
Evaluating	Making considerations and decisions using knowledge, experience, skills, and values as well as giving justification.
Analysing	Breaking down information into smaller parts in order to understand and make connections between these parts.
Applicating	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 sound judgments using logical reasoning 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 challenge them to think at a higher level.

The teaching and learning of mathematics emphasizes active pupils' 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 building.

Inquiry-based is an approach that emphasizes learning through experience. Inquiry generally means to seek information, to question and to investigate real-life phenomena. 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, analyze patterns and thus form their own conclusions. Teachers then guide pupils to discuss and understand the concept of mathematics through the inquiry results. KSSM Mathematics 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 discipline 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 that involve 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, mathematical exploration and investigation and student-centred activities with the aid of mathematical tools that are appropriate, comprehensive 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 mindful in providing the ecosystem of learning and intellectual discussions that require pupils to collaborate in solving meaningful and challenging tasks.

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 developing skills of creativity and innovation 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 has aesthetic values that 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.

Other diversified teaching and learning approaches and strategies such as mastery learning, contextual learning, constructivism, project-based learning, problem-based learning and so on should be implemented in accordance to the needs and appropriateness.

STEM[1] APPROACH

STEM approach is the teaching and learning method which applies integrated knowledge, skills and values of STEM through inquiry, problem solving or project in the context of daily life, environment and local as well as global community, as shown in Diagram 3.

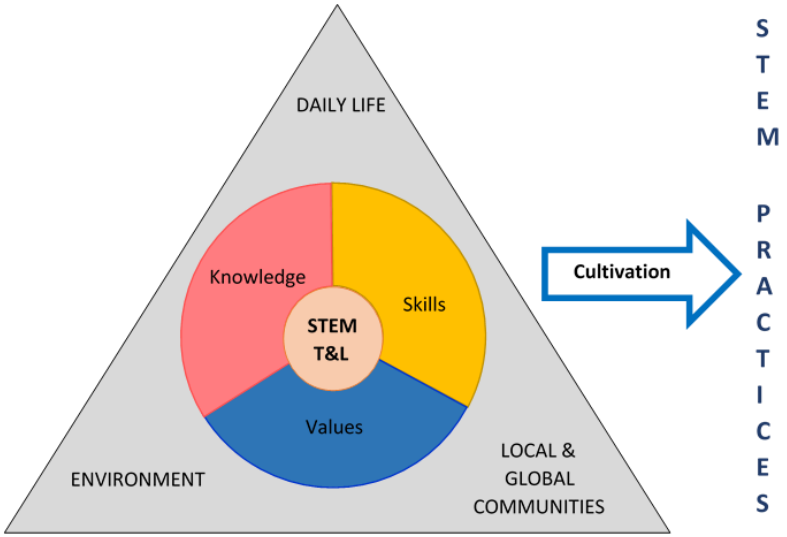

Diagram 3: STEM Teaching and Learning Approach

[1]STEM is an abbreviation for Science, Technology, Engineering and Mathematics. STEM education is the idea of educating pupils in these four specific disciplines through an interdisciplinary and applied approach based on real-world scenario.

STEM teaching and learning which is contextual and authentic is able to encourage in-depth learning among pupils. Pupils can work in groups or individually according to their ability to cultivate the STEM practices,as follows;

1. Questioning and identifying problems,
2. Developing and using models,
3. Planning and carrying out investigations,
4. Analyzing and interpreting data,
5. Using mathematical and computational thinking,
6. Developing explanation and designing solutions,
7. Engaging in argument and discussion based on evidence, and
8. Acquiring information, evaluating and communicating about the information.

CROSS-CURRICULAR ELEMENTS

Cross-curricular Elements (EMK) are 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:

1. Language

- The use of proper language of instruction should be emphasized in all subjects.
- During the teaching and learning of every subject, the aspects of pronunciation, sentence structure, grammar and vocabulary 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' ethics in appreciating nature.

3. Good Moral Values

- Good moral values are emphasized in all subjects so that pupils are aware of the importance of such values; hence practice them.
- 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 and Innovation

- Creativity is the ability to use imagination to collect, assimilate and generate ideas or create something new or original through inspiration or combinations of existing ideas.
- Innovation is the application of creativity through modification, improving 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

- Inculcation 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.
- 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.

9. Global Sustainability

- Global Sustainability elements aim to produce pupils who have sustainable thinking and are responsive to the environment in their daily lives by applying the knowledge, skills and values acquired through the elements of Sustainable Consumption and Production, Global Citizenship and Unity.
- The Global Sustainability elements are significant in preparing pupils to face the challenges and current issues at different levels; local, national and global.
- These elements are taught both directly and indirectly in the relevant subjects.

10. Financial Education

- Application of financial education elements aims at shaping the future generation that is capable of making right financial decisions, ethical practice and financial management skills to manage the financial affairs responsibly.
- Elements of financial education can be applied in teaching and learning directly or indirectly. Direct application is done through the titles that contain explicit financial elements such as the calculation of simple interest and compound interest. Indirect application is integrated through other titles across the curriculum. Exposure to financial management in real life is important to provide pupils with the knowledge, skills and values that can be applied effectively and meaningfully.

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 localized principles. Information obtained from the school

assessments will be used by administrators, teachers, parents and pupils in planning follow-up actions towards improving the pupils' learning development.

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'capability 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 pupils to exhibit a wide range of learning abilities;
- Fair to all pupils; 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 mathematical processes and 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	INTERPRETATION
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 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.

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 the practice of good values, based on Table 5.

Table 5: Value Assessment in Mathematics Education

VALUE IN MATHEMATICS EDUCATION		INTERNALISATION LEVEL
1	Interested in learning mathematics.	**Low:** 1, 2 or 3 out of all the standards listed are observed **Medium** 4, 5 or 6 out of all the standards listed are observed **High** 7, 8 or 9 out of all the standards listed are observed
2	Appreciate the aesthetic values and the importance of mathematics.	
3	Confident and patient in learning mathematics.	
4	Willing to learn from mistakes.	
5	Work towards accuracy.	
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 awarded to each pupil.

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 pupils' activities on a continuous basis through various media such as achievement in examination scores, topical tests, observations, exercises, presentations, pupils' verbal responses, group work, projects and so on. Elements which are emphasized in the overall competency level should be developed integratedly among the pupils through various tasks. Therefore, teachers have to use their wisdom in making professional judgment to determine pupils' overall performance level. 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 6 below is referred to when evaluating and reporting pupils' overall performance level.

Table 6: 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 clearly defined; 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;interpret the results obtained.
3	Pupils are able to:perform procedures that are stated clearly, including multi-steps procedures; apply simple problem- solving strategies, interpret and use representations based on different sources of information; make direct reasoning; communicate briefly when giving 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 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 of

PERFORMANCE LEVEL	CONTENTS, SKILLS AND MATHEMATICAL PROCESSES
	mathematical thinking and reasoning skills; demonstrate in-depth understanding; form new approaches and strategies to handle new situations; conclude and communicate with explanations and arguments based on interpretations, discussions, reflections and actions accurately.

Based on the Overall Competency 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-life situations. It is important that teachers carry out comprehensive assessments and provide fair and just report of each pupil's Performance Level.

CONTENT ORGANISATION

KSSM Mathematics consists of three 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 period which encompasses the aspects of knowledge, skills and values.

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

There is also a Notes column which details out the:

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

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

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 that suit the capabilities and interests of their pupils.

LEARNING AREA

NUMBER AND OPERATIONS

TITLE

1.0 PATTERNS AND SEQUENCES

1.0 PATTERNS AND SEQUENCES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
1.1 Patterns	1.1.1 Recognise and describe patterns of various number sets and objects based on real life situations, and hence make generalisation on patterns.	Various number sets including even numbers, odd numbers, Pascal's Triangle and Fibonacci Numbers.
1.2 Sequences	1.2.1 Explain the meaning of sequence. 1.2.2 Identify and describe the pattern of a sequence, and hence complete and extend the sequence.	Exploratory activities that involve geometrical shapes, numbers and objects must be carried out.
1.3 Patterns and Sequences	1.3.1 Make generalisation about the pattern of a sequence using numbers, words and algebraic expressions. 1.3.2 Determine specific terms of a sequence. 1.3.3 Solve problems involving sequences.	

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

LEARNING AREA

RELATIONSHIP AND ALGEBRA

TITLE

2.0 FACTORISATION AND ALGEBRAIC FRACTIONS

2.0 FACTORISATION AND ALGEBRAIC FRACTIONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
2.1 Expansion	2.1.1 Explain the meaning of the expansion of two algebraic expressions. 2.1.2 Expand two algebraic expressions. 2.1.3 Simplify algebraic expressions involving combined operations, including expansion. 2.1.4 Solve problems involving expansion of two algebraic expressions.	Various representations such as algebra tiles should be used. Limit to problems involving linear algebraic expressions.
2.2 Factorisation	2.2.1 Relate the multiplication of algebraic expressions to the concept of factors and factorisation, and hence list out the factors of the product of the algebraic expressions. 2.2.2 Factorise algebraic expressions using various methods. 2.2.3 Solve problems involving factorisation.	Factorisation as the inverse of expansion can be emphasized. Various methods including the use of common factors and other methods such as cross multiplication or using algebra tiles.

2.0 FACTORISATION AND ALGEBRAIC FRACTIONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
2.3 Algebraic Expressions and Laws of Basic Arithmetic Operations.	2.3.1 Perform addition and subtraction of algebraic expressions involving expansion and factorisation. 2.3.2 Perform multiplication and division of algebraic expressions involving expansion and factorisation. 2.3.3 Perform combined operations of algebraic expressions involving expansion and factorisation.	Algebraic expressions including algebraic fractions.

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of factors.
2	Demonstrate the understanding of the concept of expansion and factorisation.
3	Apply the understanding of expansion and factorisation to perform simple tasks.
4	Apply appropriate knowledge and skills of expansion and factorisation in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of expansion and factorisation in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of expansion and factorisation in the context of non-routine problem solving in a creative manner.

LEARNING AREA

RELATIONSHIP AND ALGEBRA

TITLE

3.0 ALGEBRAIC FORMULAE

3.0 ALGEBRAIC FORMULAE

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
3.1 Algebraic Formulae	3.1.1 Write a formula based on a situation. 3.1.2 Change the subject of formula of an algebraic equation. 3.1.3 Determine the value of a variable when the value of another variable is given. 3.1.4 Solve problems involving formulae.	Situation includes statements such as “the square of a number is nine”.

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

LEARNING AREA

MEASUREMENT AND GEOMETRY

TITLE

4.0 POLYGONS

4.0 POLYGONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
4.1 Regular Polygons	4.1.1 Describe the geometric properties of regular polygons using various representations.	Exploratory activities involving various methods such as the use of concrete materials (e.g. origami) or dynamic geometric software should be carried out. Activities to compare and contrast regular and irregular polygons, and to emphasise the congruency of angles should be involved. Geometric properties including length of sides, angles and the number of axes of symmetry.
	4.1.2 Construct regular polygons using various methods and explain the rationales for the steps of construction.	Various methods including the use of dynamic geometric software. Suggestion for enrichment activity: Design patterns using polygons including 3-dimensional objects.
4.2 Interior Angles and Exterior Angles of Polygons	4.2.1 Derive the formula for the sum of interior angles of a polygon.	Exploratory activities using various methods such as the use of dynamic geometric software should be carried out.

4.0 POLYGONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	4.2.2 Make and verify conjectures about the sum of exterior angles of a polygon. 4.2.3 Determine the values of interior angles, exterior angles and the number of sides of a polygon. 4.2.4 Solve problems involving polygons.	

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of regular and irregular polygons.
2	Demonstrate the understanding of the construction of regular polygons.
3	Apply the understanding of interior angles, exterior angles and number of sides of a polygon to perform simple tasks.
4	Apply appropriate knowledge and skills of polygons in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of polygons in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of polygons in the context of non-routine problem solving in a creative manner.

LEARNING AREA

MEASUREMENT AND GEOMETRY

TITLE

5.0 CIRCLES

5.0 CIRCLES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
5.1 Properties of Circles	5.1.1 Recognise parts of a circle and explain the properties of a circle. .	Exploratory activities with various methods such as using dynamic geomety software should be carried out.
	5.1.2 Construct a circle and parts of the circle based on the conditions given.	Parts of a circle including diameter, chord and sector. Example of conditions: a) Construct a circle – given the radius or diameter. b) Construct a diameter – through a certain point in a circle given the centre of the circle. c) Construct a chord - through a certain point on the circumference given the length of the chord. d) Construct a sector – given the angle of the sector and the radius of the circle. The use of dynamic geometry software is encouraged.

5.0 CIRCLES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
5.2 Symmetrical Properties of Chords.	5.2.1 Verify and explain that (i) diameter of a circle is an axis of symmetry of the circle; (ii) a radius that is perpendicular to a chord bisects the chord and vice versa; (iii) perpendicular bisectors of two chords intersect at the centre; (iv) chords that are equal in length produce arcs of the same length and vice versa; (v) chords that are equal in length are equidistant from the centre of the circle and vice versa 5.2.2 Determine the centre and radius of a circle by geometrical construction. 5.2.3 Solve problems involving symmetrical properties of chords.	Exploratory activities with various methods such as using dynamic geomety software should be carried out.
5.3 Circumference and Area of a Circle.	5.3.1 Determine the relationship between circumference and diameter of a circle, and hence define π and derive the circumference formula.	Exploratory activities for Learning Standards 5.3.1 and 5.3.2 should be carried out by using concrete materials or dynamic geometrical software.

5.0 CIRCLES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	5.3.2 Derive the formula for the area of a circle. 5.3.3 Determine the circumference, area of a circle, length of arc, area of a sector and other related measurements. 5.3.4 Solve problems involving circles.	Insight on proportions need to be stressed.

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

LEARNING AREA

MEASUREMENT AND GEOMETRY

TITLE

6.0 THREE-DIMENSIONAL GEOMETRICAL SHAPES

6.0 THREE-DIMENSIONAL GEOMETRICAL SHAPES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
6.1 Geometric Properties of Three-Dimensional Shapes	6.1.1 Compare, contrast and classify three-dimensional shapes including prisms, pyramids, cylinders, cones and spheres, and hence describe the geometric properties of prisms, pyramids, cylinders, cones and spheres.	The concept of dimension in two and three-dimensional shapes should be discussed. Exploratory activities should be carried out by using concrete materials or dynamic geometry softwares. Three-dimensional objects including oblique shapes. Example of geometric property of prisms: Uniform cross section is in the shape of a polygon, other faces are quadrilaterals.
6.2 Nets of Three-Dimensional Shapes	6.2.1 Analyse various nets including pyramids, prisms, cylinders and cones, and hence draw nets and build models.	
6.3 Surface Area of Three-Dimensional Shapes	6.3.1 Derive the formulae of the surface areas of cubes, cuboids, pyramids, prisms, cylinders and cones,and hence determine the surface areas of the shapes. 6.3.2 Determine the surface area of spheres using formula.	Exploratory activities should be carried out involving only vertical shapes.

6.0 THREE-DIMENSIONAL GEOMETRICAL SHAPES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	6.3.3 Solve problems involving the surface area of three-dimensional shapes.	Combined three-dimensional shapes and unit conversion should be included.
6.4 Volume of Three-Dimensional Shapes	6.4.1 Derive the formulae of the volumes of prisms and cylinders, and hence derive the formulae of pyramids and cones. 6.4.2 Determine the volume of prisms, cylinders, cones, pyramids and spheres using formulae. 6.4.3 Solve problems involving the volume of three-dimensional shapes.	Involve vertical shapes only. Combined three-dimensional shapes and unit conversion should be included.

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of three-dimensional shapes.
2	Demonstrate the understanding of the geometric properties of three-dimensional shapes.
3	Apply the understanding of nets, surface areas and volumes of three-dimensional shapes to perform simple tasks.
4	Apply appropriate knowledge and skills of three-dimensional shapes in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of in the context of three-dimensional shapes of complex routine problem solving.
6	Apply appropriate knowledge and skills of three-dimensional shapes in the context of non-routine problem solving in a creative manner.

LEARNING AREA

RELATIONSHIP AND ALGEBRA

TITLE

7.0 COORDINATES

7.0 COORDINATES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
7.1 Distance in the Cartesian Coordinate System	7.1.1 Explain the meaning of distance between two points on the Cartesian plane.	The meaning of distance between two points should be explained based on exploratory outcomes.
	7.1.2 Derive the formula of the distance between two points on the Cartesian plane.	Exploratory activites to derive the distance formula should be carried out.
	7.1.3 Determine the distance between two points on the Cartesian plane.	
	7.1.4 Solve problems involving the distance between two points in the Cartesian coordinate system.	
7.2 Midpoint in the Cartesian Coordinate System	7.2.1 Explain the meaning of midpoint between two points on the Cartesian plane.	The meaning of midpoint between two points should be explained based on exploratory outcomes.
	7.2.2 Derive the formula of the midpoint between two points on the Cartesian plane.	Exploratory activites to derive the midpoint formula should be carried out.
	7.2.3 Determine the coordinates of midpoint between two points on the Cartesian plane.	
	7.2.4 Solve problems involving midpoint in the Cartesian coordinate system.	

7.0 COORDINATES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
7.3 The Cartesian Coordinate System	7.3.1 Solve problems involving the Cartesian coordinate system.	

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of distance and midpoint on the Cartesian plane.
2	Demonstrate the understanding of distance and midpoint on the Cartesian plane.
3	Apply the understanding of distance and midpoint on the Cartesian plane to perform simple tasks.
4	Apply appropriate knowledge and skills of distance and midpoint on the Cartesian plane in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of distance and midpoint on the Cartesian plane in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of the Cartesian coordinate system in the context of non-routine problem solving in a creative manner.

LEARNING AREA

RELATIONSHIP AND ALGEBRA

TITLE

8.0 GRAPHS OF FUNCTIONS

8.0 GRAPHS OF FUNCTIONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
8.1 Functions	8.1.1 Explain the meaning of functions.	Exploratory activities involving the relationship between two quantities in daily life situations should be carried out.
	8.1.2 Identify functions and provide justifications based on function representations in the form of ordered pairs, tables, graphs and equations.	One-to-one functions and many-to-one functions should be involved. The concept of variable as a functional relationship associated with the concept of variable as unknown under linear equations topic. The function notation, f(x), should be introduced.
8.2 Graphs of Functions	8.2.1 Construct tables of values for linear and non-linear functions, and hence draw the graphs using the scale given.	Linear and non-linear functions including those representing real life situations. Functions in the form of $y = ax^n$, $n = -2, -1, 1, 2, 3$, $a \neq 0$, should be involved.

8.0 GRAPHS OF FUNCTIONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	8.2.2 Interpret graphs of functions.	Graphs of functions including those representing real life situations. Interpreting graphs of functions is like studying trends and making predictions.
	8.2.3 Solve problems involving graphs of functions.	Solving equations by determining the point(s) of intersection of two graphs should be involved.

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

LEARNING AREA

RELATIONSHIP AND ALGEBRA

TITLE

9.0 SPEED AND ACCELERATION

9.0 SPEED AND ACCELERATION

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
9.1 Speed	9.1.1 Explain the meaning of speed as a rate involving distance and time.	The meaning of speed should be explained based on exploratory outcomes.
	9.1.2 Describe the differences between uniform and non-uniform speed.	Various representations including tables and graphs should be used based on various situations.
	9.1.3 Perform calculation involving speed and average speed including unit conversion.	
	9.1.4 Solve problems involving speed.	
9.2 Acceleration	9.2.1 Explain the meaning of acceleration and deceleration as a rate involving speed and time.	The meaning of acceleration and deceleration should be explained based on exploratory outcomes. Limited movement towards a fixed direction.
	9.2.2 Perform calculations involving acceleration including unit conversion.	
	9.2.3 Solve problems involving acceleration.	

PERFORMANCE STANDARD	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of speed and acceleration.
2	Demonstrate the understanding of speed and acceleration.
3	Apply the understanding of speed and acceleration to perform calculations.
4	Apply appropriate knowledge and skills of speed and acceleration in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of speed and acceleration in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of speed and acceleration in the context of non-routine problem solving in a creative manner.

LEARNING AREA

RELATIONSHIP AND ALGEBRA

TITLE

10.0 GRADIENT OF A STRAIGHT LINE

10.0 GRADIENT OF A STRAIGHT LINE

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
10.1 Gradient	10.1.1 Describe gradient and direction of inclination based on real life situations, and then explain the meaning of gradient as a ratio of vertical distance to horizontal distance.	
	10.1.2 Derive the formulae for gradient of a straight line in the Cartesian plane.	Carry out exploratory activities involving various methods such as the use of dynamic software. Discuss the case of a straight line that passes through the origin and a straight line that is parallel to the axis. Formulae of gradient are: $m = \frac{y_2 - y_1}{x_2 - x_1}$ and $m = \frac{-\text{ y - intercept}}{\text{x - intercept}}$
	10.1.3 Make generalisation for the gradient of a straight line.	Exploratory activities involving all cases of gradient should be carried out.

10.0 GRADIENT OF A STRAIGHT LINE

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
		Examples of generalisation: (a) The bigger the absolute value of the gradient, the steeper the straight line. (b) The positive or negative sign of the gradient value indicates the direction of inclination in a straight line.
	10.1.4 Determine the gradient of a straight line.	Real life situations should be involved. The relationship between concrete, graphic and symbolic representations should be done. Reasons why the ratio of vertical distance to horizontal distance is used to determine the gradient, and not otherwise, should be discussed.
	10.1.5 Solve problems involving the gradient of a straight line.	

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

LEARNING AREA

MEASUREMENT AND GEOMETRY

TITLE

11.0 ISOMETRIC TRANSFORMATIONS

11.0 ISOMETRIC TRANSFORMATIONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
11.1 Transformations	11.1.1 Describe the changes of shapes, sizes, directions and orientations of an object under a transformation, and hence explain the idea of one-to-one correspondence between points in a transformation.	Exploratory activities involving examples of real life when the object is reflected, rotated, moved and enlarged or reduced in size, should be carried out. The use of digital technology is encouraged.
	11.1.2 Explain the idea of congruency in transformations.	The differences between congruency and similarity should be discussed.
11.2 Translation	11.2.1 Recognise a translation.	Exploratory activites by using dynamic geomety software should be carried out. The properties of image should be discussed.
	11.2.2 Describe translation by using various representations including vector form.	Examples of various representations are graphic, language and symbol. Vector translations can be written as $\underset{AP}{\rightarrow}$ and $\begin{pmatrix} a \\ b \end{pmatrix}$.

11.0 ISOMETRIC TRANSFORMATIONS

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	11.2.3 Determine the image and object under a translation. 11.2.4 Solve problems involving translation.	
11.3 Reflection	11.3.1 Recognise a reflection. 11.3.2 Describe reflection using various representations. 11.3.3 Determine the image and object under a reflection. 11.3.4 Solve problems involving reflection.	Exploratory activities with various methods using dynamic geomety software should be carried out. Properties of image should be discussed. Symbolic representation is excluded. Symmetrical properties of reflection should be discussed.
11.4 Rotation	11.4.1 Recognise a rotation.	Exploratory activities with various methods using dynamic geomety software should be carried out. Properties of image should be discussed.

11.0 ISOMETRIC TRANSFORMATIONS

CONTENT STANDARDS	CONTENT STANDARDS	CONTENT STANDARDS
	11.4.2 Describe rotation using various representations. 11.4.3 Determine the image and object under a rotation. 11.4.4 Solve problems involving rotation.	Symbolic representation is excluded
11.5 Translation, Reflection and Rotation as an Isometry	11.5.1 Investigate the relationship between the effects of translation, reflection and rotation and the distance between two points on an object and image, and hence explain isometry. 11.5.2 Explain the relationship between isometry and congruency. 11.5.3 Solve problems involving isometry and congruency.	Examples of non-isometry should be included. Isometry is a transformation which preserves the distance between any two points.
11.6 Rotational Symmetry	11.6.1 Explain rotational symmetry. 11.6.2 Determine the order of rotational symmetry of an object.	Carry out exploratory activites involving only two-dimensional objects.

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of translation, reflection and rotation.
2	Demonstrate the understanding of translation, reflection and rotation.
3	Apply the understanding of translation, reflection and rotation to perform simple tasks.
4	Apply appropriate knowledge and skills of translation, reflection and rotation in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of translation, reflection and rotation in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of translation, reflection and rotation in the context of non-routine problem solving in a creative manner.

LEARNING AREA

STATISTICS AND PROBABILITY

TITLE

12.0 MEASURES OF CENTRAL TENDENCIES

12.0 MEASURES OF CENTRAL TENDENCIES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
12.1 Measures of Central Tendencies	12.1.1 Determine the mode, mean and median of a set of ungrouped data.	Calculators or softwares are used in this topic where appropriate. Questions generated towards data collection based on real life situations, and hence collect and use the data to describe measures of central tendencies should be involved. Real life situations may involve cross-curricullar elements (EMK) such as: (a) students' pocket money (b) commodities market (c) tourism (d) usage of technology tools The effects of extreme values should be discussed. The term 'measures of central tendencies' should be introduced.
	12.1.2 Make conclusions about the effect of changes in a set of data to the value of mode, mean and median.	Exploratory activities involving uniform and non-uniform changes should be carried out.

12.0 MEASURES OF CENTRAL TENDENCIES

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	12.1.3 Collect data, construct and interpret the frequency table for grouped data.	Exploratory activities should be carried out in which students develop understanding in data organising and making conclusions systematically. Example: classifying data into several categories (pass and fail)/level / rank.
	12.1.4 Determine the modal class and mean of a set of grouped data.	
	12.1.5 Choose and justify the appropriate measures of central tendencies to describe the distribution of a set of data, including those with extreme values.	Data sets in the form of representations such as tables, pie charts, bar charts, stem-and-leaf plots should be involved.
	12.1.6 Determine mode, mean and median from data representations.	
	12.1.7 Apply the understanding of measures of central tendencies to make predictions, form convincing arguments and make conclusions.	Comparison of two or more sets of data should be involved. The importance of range in the comparison should be emphasized

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of mode, mean and median.
2	Demonstrate the understanding of mode, mean and median.
3	Apply the understanding of mode, mean and median to perform simple tasks.
4	Apply appropriate knowledge and skills of mode, mean and median in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of in the context of mode, mean and median of complex routine problem solving.
6	Apply appropriate knowledge and skills of mode, mean and median in the context of non-routine problem solving in a creative manner.

LEARNING AREA

STATISTICS AND PROBABILITY

TITLE

13.0 SIMPLE PROBABILITY

13.0 SIMPLE PROBABILITY

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
13.1 Experimental Probability	13.1.1 Perform simple probability experiments, and hence state the ratio $\frac{\text{frequency of an event}}{\text{number of trials}}$ as the experimental probability of an event.	
	13.1.2 Make conclusions about the experimental probability of an event when the number of trials are large enough.	Softwares should be used to perform simulations. The conclusion to be made is that the experimental probability tends to a certain value if the experiment is repeated with a large enough number of trials.
13.2 Probability Theory involving Equally Likely Outcomes	13.2.1 Determine the sample space and events of an experiment.	Exploratory activities involving real life situations in order to develop the idea of sample space and events shoud be carried out. Tree diagrams and sets should be used .

13.0 SIMPLE PROBABILITY

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
	13.2.2 Construct probability models for an event, and hence make connection between theoretical probability and experimental probability.	The probability model for an event A is represented by $P(A) = \frac{n(A)}{n(S)}$ The connection that should be made is that the experimental probability converges to the theoretical probability when the number of trials is large enough. $\frac{\text{Number of occurrances of event A}}{\text{Number of trials}} \rightarrow \frac{n(A)}{n(S)}$
	13.2.3 Determine the probability of an event.	Events that involve cross-curricular elements (EMK) such as : (a) students'pocket money (b) sales of goods (c) weather (d) usage of technology tools

13.0 SIMPLE PROBABILITY

CONTENT STANDARDS	LEARNING STANDARDS	NOTES
13.3 Probability of the Complement of an Event	13.3.1 Describe the complement of an event in words and by using set notations. 13.3.2 Determine the probability of the complement of an event.	Exploratory activities should be carried out by connecting to the concept of set in order to make these generalisations: $P(A) + P(A') = 1$ $P(A') = 1 - P(A)$ $0 \leq P(A) \leq 1$
13.4 Simple Probability	13.4.1 Solve problems involving the probability of an event.	

PERFORMANCE STANDARDS	
PERFORMANCE LEVEL	**DESCRIPTOR**
1	Demonstrate the basic knowledge of sample space and events.
2	Demonstrate the understanding of the relationship between sample space and events with simple probability.
3	Apply the understanding of simple probability to perform simple tasks.
4	Apply appropriate knowledge and skills of simple probability in the context of simple routine problem solving.
5	Apply appropriate knowledge and skills of simple probability in the context of complex routine problem solving.
6	Apply appropriate knowledge and skills of simple probability in the context of non-routine problem solving in a creative manner.

This curriculum document is published in Bahasa Melayu and English language. If there is any conflict or inconsistency between the Bahasa Melayu version and the English version, the Bahasa Melayu version shall, to the extent of the conflict or inconsistency, prevail.

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