

PRIMARY MATHEMATICS SYLLABUS

**CURRICULUM PLANNING AND DEVELOPMENT DIVISION
MINISTRY OF EDUCATION
SINGAPORE**

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INTRODUCTION

The Ministry of Education's vision of "Thinking Schools, Learning Nation" gives impetus for the infusion of three initiatives; Thinking Skills, Information Technology (IT) and National Education into the curriculum. As we move towards a knowledge-based society which is powered by IT, the need to prepare our people for the challenges and opportunities of the future becomes obvious. Besides being proficient in the use of IT, pupils will need to be able to think creatively, learn independently and work successfully in teams. Above all, as Singapore's economy moves towards globalisation, they need to have a strong feeling for home and remain Singaporean in heart, mind and being. Against this background and with the Desired Outcomes of Education as the overarching aim, the mathematics syllabus was revised.

This revised mathematics syllabus reflects the recent developments in mathematics education. The focus of the syllabus is mathematical problem solving. The emphasis is the development of concepts, skills and its underlying processes. This, together with the explication of thinking skills and the integration of IT in mathematics teaching and learning, will give leverage to the development of mathematical problem solving.

This syllabus consists of two parts.

Part A explains the philosophy of the syllabus and the spirit in which it should be implemented. It also spells out the aims and objectives of the mathematics programme.

The framework of the mathematics programme summarises the essence of mathematics teaching and learning in schools. The learning of mathematics at all levels involves more than the basic acquisition of concepts and skills. It also involves an understanding of mathematical thinking, general problem-solving strategies, having positive attitudes to and an appreciation of mathematics as an important and powerful tool in everyday life.

This framework forms the basis for mathematics teaching and learning in schools.

The objectives of the mathematics programme for the foundation stage and the orientation stage are summarised to provide an overview of the concepts and skills introduced at each level.

Part B gives the syllabus content for each level. Care has been taken to ensure that there is continuity from the primary to the secondary level. In the syllabus, the spiral approach is adopted to ensure that each topic is covered at appropriate levels in increasing depth. This enables pupils to consolidate the concepts and skills learnt and to develop further concepts and skills. The content for the EM3 stream repeats some of the important topics covered in the foundation stage. This is to ensure that pupils have a good understanding of basic mathematical concepts covered in the foundation stage before they proceed to other topics in the orientation stage.

This syllabus is a guide for teachers to plan their mathematics programmes. Teachers need not be bound by the sequence of topics presented here but should ensure that hierarchy and linkages are maintained. Teachers should exercise flexibility and creativity when using the syllabus.

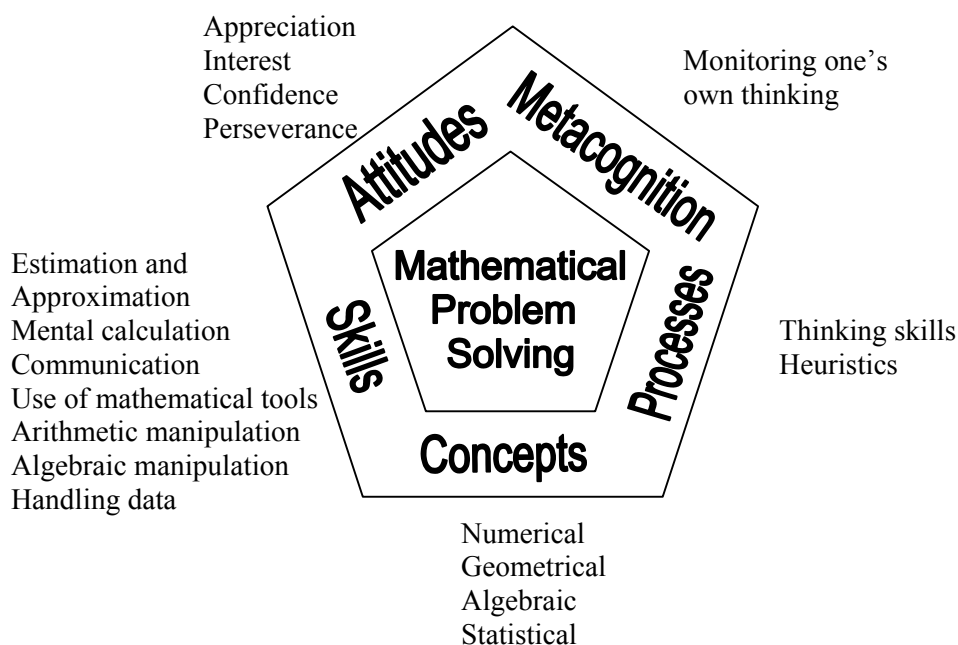
AIMS OF MATHEMATICS EDUCATION IN SCHOOLS

Mathematics education aims to enable pupils to

- acquire and apply skills and knowledge relating to number, measure and space in mathematical situations that they will meet in life
- acquire mathematical concepts and skills necessary for a further study in Mathematics and other disciplines
- develop the ability to make logical deduction and induction as well as to explicate their mathematical thinking and reasoning skills through solving of mathematical problems
- use mathematical language to communicate mathematical ideas and arguments precisely, concisely and logically
- develop positive attitudes towards Mathematics including confidence, enjoyment and perseverance
- appreciate the power and structure of Mathematics, including patterns and relationships, and to enhance their intellectual curiosity

FRAMEWORK OF THE MATHEMATICS CURRICULUM

The conceptualisation of the mathematics curriculum is based on the following framework:



The primary aim of the mathematics curriculum is to enable pupils to develop their ability in mathematical problem solving. Mathematical problem solving includes using and applying mathematics in practical tasks, in real life problems and within mathematics itself. In this context, a problem covers a wide range of situations from routine mathematical problems to problems in unfamiliar contexts and open-ended investigations that make use of the relevant mathematics and thinking processes.

The attainment of problem solving ability is dependent on five inter-related components - Concepts, Skills, Processes, Attitudes and Metacognition.

1 Concepts

Concepts refer to the basic mathematical knowledge needed for solving mathematical problems. They cover the following:

- Numerical concepts
- Geometrical concepts
- Algebraic concepts
- Statistical concepts

2 Skills

Skills refer to the topic-related manipulative skills that pupils are expected to perform when solving problems. They include:

- estimation and approximation
- mental calculation
- communication
- use of mathematical tools

- arithmetic manipulation
- algebraic manipulation
- handling data

3 Processes

Processes refer to the thinking and heuristics involved in mathematical problem solving. Some thinking skills and heuristics which are applicable to problem solving at the primary level are listed below:

Thinking skills:

- Classifying
- Comparing
- Sequencing
- Analysing Parts & Whole
- Identifying Patterns & Relationships
- Induction
- Deduction
- Spatial Visualisation

Heuristics for problem solving:

- Act it out
- Use a diagram/model
- Make a systematic list
- Look for pattern(s)
- Work backwards
- Use before-after concept
- Use guess and check
- Make suppositions
- Restate the problem in another way
- Simplify the problem
- Solve part of the problem

(Refer to Appendix A for the definitions of the suggested thinking skills)

4 Attitudes

Attitudes refer to the affective aspects of mathematics learning such as:

- enjoy doing mathematics
- appreciate the beauty and power of mathematics
- show confidence in using mathematics
- persevere in solving a problem

5 Metacognition

Metacognition refers to the ability to monitor one's own thinking processes in problem solving. This includes:

- constant and conscious monitoring of the strategies and thinking processes used in carrying out a task
- seeking alternative ways of performing a task
- checking the appropriateness and reasonableness of answers

This framework encompasses the whole mathematics curriculum from primary to secondary school.

OBJECTIVES OF THE PRIMARY MATHEMATICS CURRICULUM

PRIMARY 1 TO PRIMARY 4

PRIMARY 5 AND PRIMARY 6 (EM1/EM2 STREAMS & EM3 STREAM)

The objectives of the primary mathematics programme are to enable pupils to:

- develop understanding of mathematical concepts:
 - Numerical
 - Geometrical
 - Statistical
 - Algebraic
- perform operations with:
 - Whole numbers
 - Fractions
 - Decimals
- recognise spatial relationships in two and three dimensions
- recognise patterns and relationships in mathematics
- use mathematical language, symbols and diagrams to represent and communicate mathematical ideas
- present and interpret information in written, graphical, diagrammatic and tabular forms
- use common systems of units
- use geometrical instruments
- perform simple algebraic manipulation
- develop ability to perform mental calculation
- develop ability to perform estimation
- develop ability to check reasonableness of results
- use mathematical concepts learnt to solve problems
- use appropriate heuristics to solve problems
- apply mathematics to everyday life problems
- think logically and derive conclusions deductively
- develop an inquiring mind through investigative activities
- enjoy learning mathematics through a variety of activities

CONTENT CHART

PRIMARY 1 TO PRIMARY 4

	WHOLE NUMBERS	MONEY, MEASURES & MENSURATION	STATISTICS	GEOMETRY	FRACTIONS
P1	<ol style="list-style-type: none"> 1. Number notation and place values up to 100 2. Cardinal and ordinal numbers 3. Comparing and ordering 4. Addition and subtraction of numbers within 100 5. Multiplication of numbers whose product is not greater than 40 6. Division of numbers not greater than 20 	<ol style="list-style-type: none"> 1. Measurement of <ul style="list-style-type: none"> • length • mass in non-standard units 2. Time (12-hour clock) <ul style="list-style-type: none"> • o'clock • half past 3. Money <ul style="list-style-type: none"> • dollars (\$) and cents (¢) • addition and subtraction of money in dollars only or in cents only 	<ol style="list-style-type: none"> 1. Picture graphs <ul style="list-style-type: none"> • Constructing, reading and interpreting 	<ol style="list-style-type: none"> 1. Shapes <ul style="list-style-type: none"> • rectangle • square • circle • triangle 2. Patterns: complete patterns according to <ul style="list-style-type: none"> • shape • size • colour 	
P2	<ol style="list-style-type: none"> 1. Number notation and place values up to 1000 2. Addition and subtraction of numbers up to 3 digits 3. Multiplication and division within the 2, 3, 4, 5 and 10 times tables 	<ol style="list-style-type: none"> 1. Measurement of <ul style="list-style-type: none"> • length : metre, centimetre • mass : kilogram, gram • volume : litre • time : hour, minute 2. Addition and subtraction of <ul style="list-style-type: none"> • length • mass • volume 3. Addition and subtraction of money (in compound units) 	<ol style="list-style-type: none"> 1. Picture graphs with scales <ul style="list-style-type: none"> • Constructing, reading and interpreting • solving problems 	<ol style="list-style-type: none"> 1. Shapes <ul style="list-style-type: none"> • semicircle • quarter circle 2. Patterns: complete patterns according to <ul style="list-style-type: none"> • shape • size • orientation • two of the above attributes 3. Lines, curves and surfaces 	<ol style="list-style-type: none"> 1. Equal parts of a whole 2. Idea of simple fractions 3. Comparing and ordering like fractions

	WHOLE NUMBERS	MONEY, MEASURES & MENSURATION	STATISTICS
P3	<ol style="list-style-type: none"> 1. Number notation and place values up to 10 000 2. Addition and subtraction of numbers up to 4 digits 3. Multiplication tables up to 10×10 4. Multiplication and division of numbers up to 3 digits by a 1-digit number 5. Odd and even numbers 	<ol style="list-style-type: none"> 1. Units of measure <ul style="list-style-type: none"> • length : kilometre, metre, centimetre • mass : kilogram, gram • time : hour, minute, second, day, week, month, year • area : square metre, square centimetre • volume : litre, millilitre 2. Addition and subtraction of length, mass, volume and time (in compound units) 3. Addition and subtraction of money (in compound units using decimal notation) 4. Perimeter of rectilinear figures 5. Area and perimeter of <ul style="list-style-type: none"> • a square • a rectangle 	<ol style="list-style-type: none"> 1. Bar graphs <ul style="list-style-type: none"> • reading and interpreting • solving problems
P4	<ol style="list-style-type: none"> 1. Number notation and place values up to 100 000 2. Approximation and estimation 3. Factors and multiples 4. Multiplication of numbers <ul style="list-style-type: none"> • up to 4 digits by a 1-digit number • up to 3 digits by a 2-digit number 5. Division of numbers up to 4 digits by a 1-digit number and by 10 	<ol style="list-style-type: none"> 1. Multiplication and division of length, mass, volume and time (in compound units) 2. Multiplication and division of money (in compound units using decimal notation) 3. Units of measure of volume: cubic centimetre, cubic metre 4. Volume of <ul style="list-style-type: none"> • a cube and a cuboid • liquid 5. Area and perimeter of a square, a rectangle and their related figures 	<ol style="list-style-type: none"> 1. Tables <ul style="list-style-type: none"> • constructing, reading and interpreting • solving problems 2. Bar graphs <ul style="list-style-type: none"> • constructing, reading and interpreting • solving problems

	GEOMETRY	FRACTIONS	DECIMALS
P3	1. Concept of angles	1. Equivalent fractions 2. Comparing and ordering unlike fractions	
P4	1. Perpendicular and parallel lines 2. Angles in degrees 3. Symmetry 4. Geometrical figures <ul style="list-style-type: none"> • rectangle • square • parallelogram • rhombus • trapezium • triangle 5. Properties of <ul style="list-style-type: none"> • a square • a rectangle 6. 2-D representation of a 3-D solid <ul style="list-style-type: none"> • cube and cuboid • solid made up of unit cubes 	1. Addition and subtraction <ul style="list-style-type: none"> • like fractions • related fractions 2. Product of a proper fraction and a whole number 3. Mixed numbers and improper fractions	1. Number notation and place values up to 3 decimal places 2. Comparing and ordering 3. Addition and subtraction up to 2 decimal places 4. Multiplication and division up to 2 decimal places by 1-digit whole number 5. Conversion between decimals and fractions 6. Approximation and estimation

PRIMARY 5 & PRIMARY 6 (EM1/EM2 STREAMS)

	WHOLE NUMBERS	MONEY, MEASURES & MENSURATION	STATISTICS	GEOMETRY	FRACTIONS
P5 EM1 EM2	<ol style="list-style-type: none"> 1. Number notation and place values up to 10 million 2. Approximation and estimation 3. Multiplication and division of numbers up to 4 digits by a 2-digit whole number 4. Order of operations 	<ol style="list-style-type: none"> 1. Conversion of units of measure involving decimals and fractions 2. Volume of a cube and a cuboid 3. Area of a triangle 	<ol style="list-style-type: none"> 1. Line graphs <ul style="list-style-type: none"> • reading and interpreting • solving problems 	<ol style="list-style-type: none"> 1. Angles <ul style="list-style-type: none"> • angles on a straight line • angles at a point • vertically opposite angles 2. 8-point compass 3. Properties of <ul style="list-style-type: none"> • a parallelogram • a rhombus • a trapezium • a triangle 4. Geometrical construction: Draw a square, a rectangle, a parallelogram, a rhombus and a triangle from given dimensions 5. Tessellation 	<ol style="list-style-type: none"> 1. Addition and subtraction of <ul style="list-style-type: none"> • mixed numbers • unlike fractions 2. Product of fractions 3. Concept of fraction as division 4. Division of a proper fraction by a whole number
P6 EM1 EM2		<ol style="list-style-type: none"> 1. Area and circumference of a circle 2. Area and perimeter of a figure related to square, rectangle, triangle and circle 3. Volume of <ul style="list-style-type: none"> • a solid made up of cubes and cuboids • liquid 	<ol style="list-style-type: none"> 1. Pie charts <ul style="list-style-type: none"> • reading and interpreting • solving problems 	<ol style="list-style-type: none"> 1. Angles in geometric figures 2. 2-D representation of a 3-D solid <ul style="list-style-type: none"> • prism • pyramid 3. Nets of <ul style="list-style-type: none"> • a cube • a cuboid • a prism • a pyramid 	

	DECIMALS	AVERAGE/ RATE/SPEED	RATIO/ PROPORTION	PERCENTAGE	ALGEBRA
P5 EM1 EM2	1. Multiplication up to 2 decimal places by a 2-digit whole number 2. Multiplication and division up to 3 decimal places by tens, hundreds, thousands	1. Average 2. Rate	1. Ratio	1. Concept of percentage 2. Percentage of a quantity	
P6 EM1 EM2		1. Time (24-hour clock) 2. Speed	1. Ratio and direct proportion	1. One quantity as a percentage of another	1. Algebraic expressions in one variable <ul style="list-style-type: none"> • simplification • evaluation

PRIMARY 5 & PRIMARY 6 (EM3 STREAM)

	WHOLE NUMBERS	MONEY, MEASURES & MENSURATION	STATISTICS	GEOMETRY
P5 EM3	<ol style="list-style-type: none"> 1. Number notation and place values up to 10 million 2. Addition and subtraction of numbers up to 4 digits 3. Multiplication of numbers <ul style="list-style-type: none"> • up to 4 digits by a 1-digit number • up to 3 digits by a 2-digit number 4. Division of <ul style="list-style-type: none"> • numbers up to 4 digits by a 1-digit number • a 2 digit-number by a 2-digit number 5. Factors and multiples 6. Approximation and estimation 	<ol style="list-style-type: none"> 1. Money <ul style="list-style-type: none"> • decimal notation • 4 operations involving money in the decimal notation 2. Units of measure: <ul style="list-style-type: none"> • length : kilometre, metre, centimetre • mass : kilogram, gram • area : square metre, square centimetre • 4 operations involving length and mass 3. Conversion of units of measure involving decimals and fractions 4. Area and perimeter of <ul style="list-style-type: none"> • a square • a rectangle 	<ol style="list-style-type: none"> 1. Tables <ul style="list-style-type: none"> • constructing, reading and interpreting • solving problems 2. Bar graphs <ul style="list-style-type: none"> • constructing, reading and interpreting • solving problems 3. Line graphs <ul style="list-style-type: none"> • reading and interpreting • solving problems 	<ol style="list-style-type: none"> 1. Perpendicular and parallel lines 2. Angles in degrees 3. Properties of a square and a rectangle 4. Symmetry
P6 EM3		<ol style="list-style-type: none"> 1. Units of measure: <ul style="list-style-type: none"> • time : hour, minute, second, day, week, month, year • volume of liquid: litre, millilitre • 4 operations involving time and volume 2. Area and perimeter of <ul style="list-style-type: none"> • a triangle • a figure related to rectangle, square and triangle 3. Volume of <ul style="list-style-type: none"> • a cube and a cuboid • liquid 	<ol style="list-style-type: none"> 1. Pie charts <ul style="list-style-type: none"> • reading and interpreting • solving problems 	<ol style="list-style-type: none"> 1. Properties of a triangle 2. Angles in geometric figures 3. Geometrical construction: Draw a square, a rectangle and a triangle from given dimensions

	FRACTIONS	DECIMALS	AVERAGE/ RATE/SPEED	RATIO/ PROPORTION	PERCENTAGE
P5 EM3	<ol style="list-style-type: none"> 1. Concept of fractions 2. Equivalent fractions 3. Improper fractions and mixed numbers 4. Comparing and ordering 5. Addition and subtraction of fractions 6. Product of fractions 7. Division of a proper fraction by a whole number 	<ol style="list-style-type: none"> 1. Number notation and place values up to 3 decimal places 2. Comparing and ordering 3. Addition and subtraction up to 2 decimal places 4. Multiplication up to 2 decimal places by a whole number up to 2 digits 5. Division up to 2 decimal places by a 1-digit whole number 6. Multiplication and division up to 2 decimal places by tens, hundreds and thousands 7. Conversion between fractions and decimals 8. Approximation 			
P6 EM3			<ol style="list-style-type: none"> 1. Average 2. Rate 	<ol style="list-style-type: none"> 1. Direct proportion 	<ol style="list-style-type: none"> 1. Concept of percentage 2. Percentage of a quantity

TOPICS/OUTCOMES	REMARKS
WHOLE NUMBERS	
1 NUMBER NOTATION AND PLACE VALUES	
Pupils should be able to	
a) count to 100	a) <ul style="list-style-type: none"> • Include completing sequences of consecutive numbers • Include counting in tens and completing sequence
b) read and write numbers up to 100 in numerals and in words	
c) Recognise the place values of numbers (tens, ones)	
2 CARDINAL AND ORDINAL NUMBERS	
d) give a number to indicate the number of objects in a given set	d) <ul style="list-style-type: none"> • Exclude the term ‘cardinal number’
e) represent a given number by a set of objects	e) <ul style="list-style-type: none"> • Include visualising small sets up to 5 objects instead of counting one by one
f) use ordinal numbers such as first, second, up to tenth	f) <ul style="list-style-type: none"> • Include symbols, e.g. 1st, 2nd, 3rd, etc. • Exclude the term ‘ordinal number’
3 COMPARING AND ORDERING	
g) compare two or more sets in terms of the difference in number	g) <ul style="list-style-type: none"> • Include the concept of one-to-one correspondence • Include use of the phrases ‘more than’, ‘less than’ and ‘fewer than’ • Include finding ‘How many more/less?’
h) compare numbers up to 100	h) <ul style="list-style-type: none"> • Include use of the words: greater, greatest, smaller, smallest • Exclude use of the symbols ‘ > ’ and ‘ < ’
i) arrange numbers in increasing and decreasing order	

TOPICS/OUTCOMES	REMARKS
WHOLE NUMBERS	
4 ADDITION AND SUBTRACTION	
j) illustrate the meaning of ‘addition’ and ‘subtraction’	j) <ul style="list-style-type: none"> • Include comparing two numbers within 20 and finding how much greater/smaller
k) write mathematical statements for given situations involving addition and subtraction	
l) build up the addition bonds up to 9 + 9 and commit to memory	l) <ul style="list-style-type: none"> • Include writing number stories for each number up to 10 • Include sums such as the following: <ul style="list-style-type: none"> (i) $\square + 2 = 7$ (ii) $3 + \square = 12$ • Exclude box sums which are beyond addition bonds such as $9 + \square = 22$
m) recognise the relationship between addition and subtraction	
n) add and subtract numbers involving <ul style="list-style-type: none"> • 2-digit numbers and ones • 2-digit numbers and tens • 2-digit numbers and 2-digit numbers 	n) <ul style="list-style-type: none"> • Exclude formal algorithm • Include addition/subtraction with renaming
o) add 3 one-digit numbers	
p) carry out simple addition and subtraction mentally involving <ul style="list-style-type: none"> • 2-digit number and ones without renaming • 2-digit number and tens 	
q) solve 1-step word problems on addition and subtraction	q) <ul style="list-style-type: none"> • Use numbers within 20
5 MULTIPLICATION	
r) illustrate the meaning of multiplication as repeated addition	
s) write mathematical statements for given situations involving multiplication	s) <ul style="list-style-type: none"> • Use numbers with product not greater than 40
t) multiply numbers whose product is not greater than 40	t,u) <ul style="list-style-type: none"> • Exclude use of multiplication tables
u) solve 1-step word problems with pictorial illustrations on multiplication	
6 DIVISION	
v) divide a quantity not greater than 20 into equal sets: <ul style="list-style-type: none"> • given the number of objects in each set • given the number of sets 	v) <ul style="list-style-type: none"> • Exclude use of division symbol



TOPICS/OUTCOMES	REMARKS
MONEY AND MEASURES	
1 MEASUREMENT OF LENGTH AND MASS	
Pupils should be able to	
a) compare the lengths/masses of two or more objects in non-standard units	a) <ul style="list-style-type: none"> • Include use of simple approximation to measure lengths and masses • Exclude finding the difference in length/mass • Include the use of the following words: <ul style="list-style-type: none"> long, longer, longest short, shorter, shortest tall, taller, tallest high, higher, highest heavy, heavier, heaviest light, lighter, lightest
2 TIME (12-HOUR CLOCK)	
b) tell time in terms of o'clock and half past	b) <ul style="list-style-type: none"> • Exclude use of 24-hour clock
3 MONEY	
c) tell the different denominations of <ul style="list-style-type: none"> • coins • notes 	
d) match one coin/note of one denomination to an equivalent set of coins/notes of another denomination	
e) tell the amount of money <ul style="list-style-type: none"> • in cents (¢) up to \$1 • in dollars (\$) up to \$100 	e) <ul style="list-style-type: none"> • Include use of symbols '\$' and '¢' • Exclude combinations of dollars and cents
f) add and subtract money <ul style="list-style-type: none"> • in dollars only • in cents only 	
g) solve 1-step word problems on addition and subtraction of money <ul style="list-style-type: none"> • in cents only • in dollars only 	g) <ul style="list-style-type: none"> • Include finding 'How much more/less?'

TOPICS/OUTCOMES	REMARKS
STATISTICS	
1 PICTURE GRAPHS	
Pupils should be able to	
a) make picture graphs of given data	a) <ul style="list-style-type: none"> • Include collecting and organising data • Include both horizontal and vertical forms • Include the use of symbolic representations, e.g. ♦ represents one child
b) read and interpret picture graphs	b) <ul style="list-style-type: none"> • Exclude picture graphs with scales such as each ♦ represents 5 children

TOPICS/OUTCOMES	REMARKS
GEOMETRY	
1 SHAPES	
Pupils should be able to	
a) Identify and name the following shapes: <ul style="list-style-type: none"> • rectangle • square • circle • triangle 	a) <ul style="list-style-type: none"> • Include classification of shapes
b) Identify the following shapes in 3-D objects: <ul style="list-style-type: none"> • rectangle • square • circle • triangle 	
2 PATTERNS	
c) complete patterns according to <ul style="list-style-type: none"> • shape • size • colour • two of the above attributes 	
d) complete patterns with 3-D solids <ul style="list-style-type: none"> • cube • rectangular block • cone • cylinder 	d) <ul style="list-style-type: none"> • Exclude use of the words ‘cube’, ‘cone’, ‘cylinder’ in written or verbal form

TOPICS/OUTCOMES	REMARKS
WHOLE NUMBERS	
1 NUMBER NOTATION AND PLACE VALUES	
Pupils should be able to	
a) count to 1000	a) • Include counting in tens and hundreds
b) read and write numbers up to 1000 in numerals and in words	b) • Include the use of zero as a place holder
c) recognise the place values of numbers (hundreds, tens, ones)	c) • Include completing number sequences
d) compare and order numbers up to 1000	d) • Include finding the difference
2 ADDITION AND SUBTRACTION	
e) add and subtract two numbers up to 3 digits	e) • Include formal algorithm • Include use of abacus (refer to Appendix B)
f) carry out addition and subtraction mentally involving <ul style="list-style-type: none"> • 3-digit number and ones • 3-digit number and tens • 3-digit number and hundreds 	
3 MULTIPLICATION AND DIVISION WITHIN THE 2, 3, 4, 5 AND 10 TIMES TABLES	
g) count in steps of 2, 3, 4, 5 and 10	g) • Include completing number sequences leading to multiplication tables
h) build up the multiplication tables of 2, 3, 4, 5 and 10 and commit to memory	h) • Include activities to help pupils see that multiplication is commutative
i) multiply numbers within the multiplication tables	
j) write mathematical statements for given situations involving division	j) • Include use of division symbol
k) divide numbers within the multiplication tables	k) • Exclude division with remainder
carry out multiplication and division within multiplication tables mentally	
4 WORD PROBLEMS	
l) solve 1-step word problems involving the four operations	

TOPICS/OUTCOMES	REMARKS
MONEY AND MEASURES	
1 MEASUREMENT OF LENGTH, MASS AND VOLUME	
Pupils should be able to	
a) estimate and measure <ul style="list-style-type: none"> • length in metres/centimetres • mass in kilograms/grams • volume in litres 	a) <ul style="list-style-type: none"> • Include the use of appropriate instruments for measuring • Include use of the appropriate measure and their abbreviations: cm, m, g, kg and ℓ • Exclude compound units • Include concept of conservation of volume of liquid • Exclude volume of solids
2 ADDITION AND SUBTRACTION OF LENGTH, MASS AND VOLUME	
b) compare <ul style="list-style-type: none"> • lengths • masses • volumes 	b) <ul style="list-style-type: none"> • Include finding the difference
c) add and subtract <ul style="list-style-type: none"> • lengths • masses • volumes 	c) <ul style="list-style-type: none"> • Exclude conversion of units
3 TIME	
d) tell and write time from the clock face	d) <ul style="list-style-type: none"> • Exclude cases where the minute hand is between two numbers • Include reading time, e.g. read '9.15' as 'nine fifteen'; '9.50' as 'nine fifty' • Include use of 'a.m.' and 'p.m.' • Include drawing hands on the clock face to show time • Include use of abbreviations: h and min • Include the concept of duration of time when reading time
4 ADDITION AND SUBTRACTION OF MONEY	
e) read and write money using decimal notation	
f) add and subtract money in compound units	f) <ul style="list-style-type: none"> • Include making 'change' • Include cases such as \$2.50 + 60¢ and \$5.75 – \$3 • Exclude cases such as \$2.50 + \$3.20 and \$5.75 – \$2.55
5 WORD PROBLEMS	
g) solve 1-step word problems involving length, mass, volume and money	

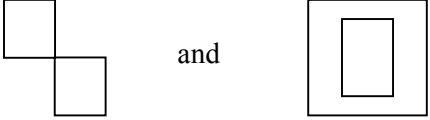
TOPICS/OUTCOMES	REMARKS
STATISTICS	
1 PICTURE GRAPHS WITH SCALES	
Pupils should be able to	
a) make picture graphs using a scale representation	a) <ul style="list-style-type: none"> Include both horizontal and vertical representations
b) read and interpret picture graphs with scales	
c) solve problems using information presented in picture graphs	c) <ul style="list-style-type: none"> Include scales such as "Each  represents 6 bags." Exclude cases involving the use of an incomplete symbolic representation such as 

TOPICS/OUTCOMES	REMARKS
FRACTIONS	
1 EQUAL PARTS OF A WHOLE	
Pupils should be able to	
a) Recognise and name unit fractions up to $\frac{1}{12}$	a) <ul style="list-style-type: none"> Exclude set of objects Include the use of symbols: $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{12}$
2 IDEA OF SIMPLE FRACTIONS	
b) recognise and name a fraction of a whole	b) <ul style="list-style-type: none"> Exclude the use of mathematical statements such as $1 - \frac{1}{4} = \frac{3}{4}$
3 COMPARING AND ORDERING FRACTIONS	
c) compare and order unit fractions and like fractions	

TOPICS/OUTCOMES	REMARKS
GEOMETRY	
1 SHAPES AND PATTERNS	
Pupils should be able to	
a) identify and name <ul style="list-style-type: none"> • a semicircle (half circle) • a quarter circle 	
b) identify the following shapes that make up a given figure: <ul style="list-style-type: none"> • square • rectangle • triangle • circle • semicircle • quarter circle 	b) <ul style="list-style-type: none"> • Include tracing the outlines of figures formed and talking about the shapes used to form the figures
c) complete patterns according to <ul style="list-style-type: none"> • shape • size • orientation • two of the above attributes 	c) <ul style="list-style-type: none"> • Include identifying the patterns and relationships
2 LINES, CURVES AND SURFACES	
d) identify straight lines and curves	d) <ul style="list-style-type: none"> • Include forming figures with straight lines and curves and describing how they form the figures
e) draw a straight line of given length	
f) identify flat and curved faces of a 3-D object	

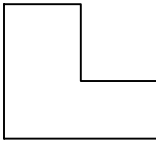
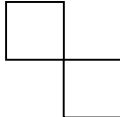
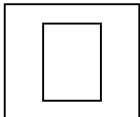
TOPICS/OUTCOMES	REMARKS
WHOLE NUMBERS	
1 NUMBER NOTATION AND PLACE VALUES	
Pupils should be able to	
a) read and write numbers up to 10 000 in numerals and in words	
b) recognise the place values of numbers (thousands, hundreds, tens, ones)	
c) compare and order numbers up to 10 000	
2 ADDITION AND SUBTRACTION	
d) add and subtract numbers up to 4 digits	d) <ul style="list-style-type: none"> • Include use of terms ‘sum’ and ‘difference’ • Include use of abacus (refer to Appendix B)
e) carry out addition and subtraction mentally involving two 2-digit numbers	
3 MULTIPLICATION TABLES UP TO 10 × 10	
f) count in steps of 2, 3, 4, 5, . . . , 10	f) <ul style="list-style-type: none"> • Include completing number sequences leading to multiplication tables
g) build up the multiplication tables up to 10 × 10 and commit to memory	
4 MULTIPLICATION AND DIVISION BY A 1-DIGIT NUMBER	
h) multiply and divide numbers up to a 3-digit number by a 1-digit number	h) <ul style="list-style-type: none"> • Include use of the terms ‘product’, ‘quotient’ and ‘remainder’ • Exclude 2-step calculation such as: Find the product of 6 and the difference between 10 and 8
i) carry out simple mental calculations	
5 ODD AND EVEN NUMBERS	
j) identify odd and even numbers	
6 WORD PROBLEMS	
k) solve up to 2-step word problems involving the four operations on whole numbers	k) <ul style="list-style-type: none"> • Include units of measure

TOPICS/OUTCOMES	REMARKS
MONEY AND MEASURES	
1 UNITS OF MEASURE	
Pupils should be able to	
a) visualise the relative magnitudes of standard units <ul style="list-style-type: none"> • kilometre and metre • metre and centimetre • kilogram and gram • litre and millilitre • hour and minute • minute and second • year and month • month and day • year and day • week and day 	a) <ul style="list-style-type: none"> • Include use of the word ‘capacity’ • Include use of abbreviations: km, m, cm, kg, g, ℓ, ml, h, min, s
b) measure in compound units <ul style="list-style-type: none"> • length : kilometre, metre, centimetre • mass : kilogram, gram • time : hour, minute, second, day, week, month, year • area : square metre, square centimetre • volume : litre, millilitre 	b) <ul style="list-style-type: none"> • Include estimating and measuring with different units • Include use of the terms ‘past’ and ‘to’ such as ‘10 minutes past 5’ and ‘15 minutes to 12’
c) carry out the following conversions, and vice versa: <ul style="list-style-type: none"> • kilometre to metre • metre to centimetre • kilogram to gram • litre to millilitre • hour to minute • minute to second • year to month • week to day 	c) <ul style="list-style-type: none"> • Include compound units • Numbers involved should be within easy manipulation
2 ADDITION AND SUBTRACTION OF LENGTH, MASS, VOLUME AND TIME	
d) add and subtract in compound units <ul style="list-style-type: none"> • length • mass • volume • time 	d) <ul style="list-style-type: none"> • Exclude seconds • Numbers involved should be within easy manipulation

TOPICS/OUTCOMES	REMARKS
MONEY AND MEASURES	
3 <i>ADDITION AND SUBTRACTION OF MONEY</i>	
e) add and subtract money in compound units using the decimal notation	
4 <i>WORD PROBLEMS</i>	
f) solve up to 2-step word problems involving money, length, mass, volume and time	f) <ul style="list-style-type: none"> • Include problems involving different units of measure • Include problems involving concept of duration of time interval
5 <i>PERIMETER OF A RECTILINEAR FIGURE</i>	
g) calculate the perimeter of a rectilinear figure <ul style="list-style-type: none"> • in centimetres • in metres 	<ul style="list-style-type: none"> • Include estimating and measuring perimeter • Exclude figures such as 
6 <i>AREA AND PERIMETER OF A SQUARE AND A RECTANGLE</i>	
h) calculate the perimeter of square and rectangle	h) <ul style="list-style-type: none"> • Exclude use of formulae
i) compare the areas of shapes in non-standard units	
j) estimate the area of a square and a rectangle in standard unit	
k) visualise the relative sizes of 1 square metre and 1 square centimetre	k) <ul style="list-style-type: none"> • Exclude conversion between cm^2 and m^2 • Include estimating area in square metres and square centimetres
l) use formula to calculate the area of a square and a rectangle	l) <ul style="list-style-type: none"> • Include use of abbreviations: cm^2, m^2

TOPICS/OUTCOMES	REMARKS
STATISTICS	
1 <i>BAR GRAPHS</i>	
Pupils should be able to	
a) read scales on the axis	a) <ul style="list-style-type: none"> • Include both horizontal and vertical representations
b) read and interpret bar graphs	
c) solve problems using information given in bar graphs	

TOPICS/OUTCOMES	REMARKS
FRACTIONS	
1 EQUIVALENT FRACTIONS	
Pupils should be able to	
a) recognise and name equivalent fractions	a) <ul style="list-style-type: none"> • Include the terms ‘numerator’ and ‘denominator’
b) list the first 8 equivalent fractions of a given fraction with denominator not greater than 12	
c) write the equivalent fraction of a fraction given the denominator/ numerator	
d) express a fraction in its simplest form	
2 COMPARING AND ORDERING	
e) compare and order related and unlike fractions with denominators up to 12	e) <ul style="list-style-type: none"> • Include both increasing and decreasing order • Number of fractions involved should not exceed 3

TOPICS/OUTCOMES	REMARKS
GEOMETRY	
1 CONCEPT OF ANGLES	
Pupils should be able to	
a) associate an angle as a certain amount of turning	
b) identify right angles	b) <ul style="list-style-type: none"> • For identifying right angles in a figure, restrict to only right angles inside the figure Example:  How many right angles are there inside the figure? (Answer: 5) • Exclude figures such as  and 
c) tell whether a given angle is greater or smaller than a right angle	c) <ul style="list-style-type: none"> • Exclude use of the terms ‘acute’, ‘obtuse’ and ‘reflex’ angles
d) identify angles in 2-D shapes	

TOPICS/OUTCOMES	REMARKS
WHOLE NUMBERS	
1 NUMBER NOTATION AND PLACE VALUES	
Pupils should be able to	
a) read and write numbers up to 100 000 in numerals and in words	
b) recognise the place values of numbers (ten thousands, thousands, hundreds, tens, ones)	b) <ul style="list-style-type: none"> • Include completing number sequences
c) compare and order numbers up to 100 000	
2 APPROXIMATION AND ESTIMATION	
d) round off numbers to the nearest 10 and 100	
e) estimate the answers in calculations involving addition, subtraction and multiplication	e) <ul style="list-style-type: none"> • Include checking reasonableness of answers
3 FACTORS AND MULTIPLES	
f) determine if a 1-digit number is a factor of a given whole number	
g) list all factors of a whole number up to 100	g) <ul style="list-style-type: none"> • Include finding common factor of 2 numbers • Exclude finding highest common factor (H. C. F.)
h) determine if a whole number is a multiple of a given 1-digit whole number	
i) list the first 12 multiples of a given 1-digit whole number	i) <ul style="list-style-type: none"> • Include finding common multiple of 2 numbers • Exclude finding lowest common multiple (L. C. M.)
4 MULTIPLICATION BY A NUMBER UP TO 2 DIGITS	
j) multiply numbers up to <ul style="list-style-type: none"> • 4 digits by a 1-digit number • 3 digits by a 2-digit number 	
5 DIVISION BY A 1-DIGIT NUMBER AND BY 10	
k) divide numbers up to 4 digits by a 1-digit number and by 10	
6 WORD PROBLEMS	
l) solve up to 3-step word problems involving whole numbers	l) <ul style="list-style-type: none"> • Include units of measure • Include checking reasonableness of answers

TOPICS/OUTCOMES	REMARKS
MONEY AND MEASURES	
1 MULTIPLICATION AND DIVISION OF LENGTH, MASS, VOLUME AND TIME	
Pupils should be able to	
a) Multiply and divide in compound units <ul style="list-style-type: none"> • Length • Mass • Volume • Time 	a) <ul style="list-style-type: none"> • Use whole numbers only • Exclude seconds • Numbers involved should be within easy manipulation
2 MULTIPLICATION AND DIVISION OF MONEY	
b) multiply and divide money in compound units using decimal notation	
3 UNITS OF MEASURE OF VOLUME: CUBIC CENTIMETRE, CUBIC METRE	
c) build solids with unit cubes and state their volumes	<ul style="list-style-type: none"> • Exclude conversion between m^3 and cm^3
d) visualise the relative sizes of 1 cubic metre and 1 cubic centimetre	
4 VOLUME OF A CUBE/CUBOID AND LIQUID	
e) use formula to find the volume of a cuboid	e) <ul style="list-style-type: none"> • Include use of abbreviations: m^3 and cm^3 • Include finding the volume of the solid made up of unit cubes of given dimension • Exclude compound units
f) use formula to find volume of liquid in a rectangular container	f) <ul style="list-style-type: none"> • Exclude compound units
g) recognise the equivalence of 1 litre/1000 ml and 1000 cm^3	g) <ul style="list-style-type: none"> • Include conversions between ℓ, ml and cm^3
5 AREA AND PERIMETER OF A SQUARE, A RECTANGLE AND THEIR RELATED FIGURES	
h) find the area/perimeter of a figure made up of squares and/or rectangles	h) <ul style="list-style-type: none"> • Include finding the area of a figure by subtraction of areas
i) find one dimension of a rectangle given the other dimension and <ul style="list-style-type: none"> • its perimeter • its area 	
j) find the side of a square given <ul style="list-style-type: none"> • its perimeter • its area 	j) <ul style="list-style-type: none"> • Exclude use of ‘$\sqrt{\quad}$’ sign
6 WORD PROBLEMS	
k) solve word problems involving <ul style="list-style-type: none"> • volume of solids/liquid • area and perimeter of squares and rectangles 	k) <ul style="list-style-type: none"> • Exclude compound units

TOPICS/OUTCOMES	REMARKS
STATISTICS	
1 TABLES	
Pupils should be able to	
a) complete a table from given information	a) <ul style="list-style-type: none"> • Include collecting data and presenting the data in a table form
b) read and interpret tables	
2 BAR GRAPHS	
c) complete a bar graph from given data	
3 WORD PROBLEMS	
d) solve problems using data presented in bar graphs and tables	

TOPICS/OUTCOMES	REMARKS
FRACTIONS	
1 ADDITION AND SUBTRACTION	
Pupils should be able to	
a) add and subtract <ul style="list-style-type: none"> • like fractions • related fractions 	a) <ul style="list-style-type: none"> • Denominators of given fractions should not exceed 12 • Exclude sums involving more than 2 different denominators
2 PRODUCT OF A PROPER FRACTION AND A WHOLE NUMBER	
b) recognise and name fractions as parts of a set of objects	
c) calculate the product of a proper fraction and a whole number	
3 MIXED NUMBERS AND IMPROPER FRACTIONS	
d) express an improper fraction as a mixed number, and vice versa	d) <ul style="list-style-type: none"> • Include expressing an improper fraction/mixed number in its simplest form
4 WORD PROBLEMS	
e) solve up to 2-step word problems involving fractions	e) <ul style="list-style-type: none"> • Include using unitary method to find the ‘whole’ given a fractional part • Exclude question such as ‘Express the number of girls as a fraction of the number of boys.’ as it will be dealt with under the topic ‘Ratio’

TOPICS/OUTCOMES	REMARKS
DECIMALS	
1 NUMBER NOTATION AND PLACE VALUES	
Pupils should be able to	
a) read and interpret decimals up to 3 decimal places	a) <ul style="list-style-type: none"> • Include use of the number line to illustrate the concept of decimals • Include identifying the values of the digits in a decimal • Include sums such as the following (i) $0.125 = \frac{1}{10} + \frac{2}{100} + \frac{\square}{1000}$ (ii) $0.125 = \frac{125}{\square}$ (iii) $21.203 = 21 + \frac{\square}{1000}$ • Exclude $0.125 = \frac{1}{10} + \frac{1}{50} + \frac{\square}{200}$
b) compare and order decimals	
2 ADDITION AND SUBTRACTION	
c) add and subtract decimals up to 2 decimal places	c) <ul style="list-style-type: none"> • Include mental calculations involving addition and subtraction of 1-digit whole numbers/tenths and tenths
3 MULTIPLICATION AND DIVISION	
d) multiply and divide decimals up to 2 decimal places by a 1-digit whole number	d) <ul style="list-style-type: none"> • Include division of whole number by whole number with decimal answers • Include rounding off answers to 2 decimal places • Include checking reasonableness of answers
e) carry out mental calculation within the multiplication tables	
4 CONVERSION BETWEEN DECIMALS AND FRACTIONS	
f) express a decimal as a fraction, and vice versa	
5 APPROXIMATION AND ESTIMATION	
g) round off decimals to <ul style="list-style-type: none"> • the nearest whole number • 1 decimal place • 2 decimal places 	g) <ul style="list-style-type: none"> • Include units of measure
h) estimate the answers in calculations involving addition, subtraction and multiplication	h) <ul style="list-style-type: none"> • Include checking reasonableness of answers
6 WORD PROBLEMS	
i) solve up to 2-step word problems involving decimals	i) <ul style="list-style-type: none"> • Include rounding off answers to a specified degree of accuracy • Include checking reasonableness of answers

TOPICS/OUTCOMES	REMARKS
GEOMETRY	
1 PERPENDICULAR AND PARALLEL LINES	
Pupils should be able to	
a) identify perpendicular and parallel lines	a,b) • Include use of the terms ‘vertical’ and ‘horizontal’
b) draw perpendicular and parallel lines using ruler and set squares	
2 ANGLES IN DEGREES	
c) estimate size of angles and measure angles in degrees using a protractor	c) • Include using notation such as $\angle ABC$ and $\angle x$ to name angles • Exclude using variable such as x° to represent size of angle • Exclude reflex angles
d) associate $\frac{1}{4}$ - turn/right angle with 90° $\frac{1}{2}$ - turn with 180° $\frac{3}{4}$ - turn with 270°	
e) draw a given angle using a protractor	e) • Exclude drawing reflex angles
3 SYMMETRY	
f) recognise symmetric figures	f) • Include identifying and visualising symmetry in the environment or in designs • Exclude rotational symmetry
g) determine whether a straight line is a line of symmetry of a figure	g) • Exclude finding the number of lines of symmetry of a symmetric figure
h) complete a symmetric figure with respect to a given line of symmetry	
4 GEOMETRICAL FIGURES	
i) identify and name the following figures: • rectangle • square • parallelogram • rhombus • trapezium	
j) identify and name the following triangles: • isosceles • equilateral • right-angled	j) • Exclude use of the terms ‘scalene’, ‘acute’ and ‘obtuse’

TOPICS/OUTCOMES	REMARKS
GEOMETRY	
5 <i>PROPERTIES OF A SQUARE AND A RECTANGLE</i>	
k) state and use properties of <ul style="list-style-type: none"> • a square • a rectangle 	k) <ul style="list-style-type: none"> • Exclude the term ‘diagonal’ and its related properties • Include finding angles and sides
6 <i>2-D REPRESENTATION OF A 3-D SOLID</i>	
l) visualise cubes and cuboids from drawings	
m) state the number of unit cubes that make up a solid	
n) visualise and identify the new solid formed by increasing/ decreasing the number of cubes of a given solid drawn on an isometric grid.	n) <ul style="list-style-type: none"> • Exclude asking pupils to draw the solid on an isometric grid

TOPICS/OUTCOMES	REMARKS
WHOLE NUMBERS	
1 NUMBER NOTATION AND PLACE VALUES	
Pupils should be able to	
a) read and write numbers up to 10 million in numerals and in words	
2 MULTIPLICATION AND DIVISION	
b) multiply and divide numbers up to 4 digits by a 2-digit whole number	
c) multiply and divide numbers by tens, hundreds and thousands	
3 APPROXIMATION AND ESTIMATION	
d) round off numbers to the nearest 1000	d) • Include use of the approximation symbol ‘ \approx ’
e) estimate the answers in calculations involving addition, subtraction and multiplication	
4 ORDER OF OPERATIONS	
f) state the order of operations and carry out combined operations involving the 4 operations	f) • Include use of brackets
5 WORD PROBLEMS	
g) solve word problems involving whole numbers	g) • Include rounding off answers to a specified degree of accuracy

TOPICS/OUTCOMES	REMARKS
MENSURATION	
1 CONVERSION OF MEASUREMENTS INVOLVING DECIMALS AND FRACTIONS	
Pupils should be able to	
a) convert measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa	a) • Exclude measurements involving decimals for time • Numbers involved should be within easy manipulation
2 VOLUME OF A CUBE/CUBOID	
b) find one dimension of a cuboid given its volume and other dimensions	b) • Exclude finding the area of a face given its volume and one dimension
c) find the edge of a cube given its volume	c) • Exclude use of ‘ $\sqrt[3]{\quad}$ ’ sign
d) solve up to 2-step word problems involving volume of a cube/cuboid and liquid	d) • Include problems involving the height of water level in rectangular tank • Exclude finding volume of solid by the volume of liquid displaced
3 AREA OF A TRIANGLE	
e) use formula to find the area of a triangle	e) • Include identifying the base and its corresponding height • Exclude finding the base or height of a triangle given its area

TOPICS/OUTCOMES	REMARKS
STATISTICS	
1 LINE GRAPHS	
Pupils should be able to	
a) read and interpret line graphs	a,b) • Exclude distance - time graphs
b) solve problems using information presented in line graphs	

TOPICS/OUTCOMES	REMARKS
FRACTIONS	
1 ADDITION AND SUBTRACTION	
Pupils should be able to	
a) add and subtract <ul style="list-style-type: none"> • mixed numbers • unlike fractions 	<ul style="list-style-type: none"> • Include listing of equivalent fractions to identify fractions with common denominator • Denominators of given fractions should not exceed 12
2 PRODUCT OF FRACTIONS	
b) calculate the product of 2 fractions	b) • Exclude mixed numbers
3 CONCEPT OF FRACTION AS DIVISION	
c) associate a fraction with division	c) • Include conversion between fractions and decimals
4 DIVISION OF A PROPER FRACTION BY A WHOLE NUMBER	
d) divide a proper fraction by a whole number	
5 WORD PROBLEMS	
e) solve word problems involving fractions	

TOPICS/OUTCOMES	REMARKS
DECIMALS	
1 MULTIPLICATION AND DIVISION	
Pupils should be able to	
a) multiply decimals up to 2 decimal places by a 2-digit whole number	a) • Include checking reasonableness of answers by estimation
b) multiply and divide decimals up to 3 decimal places by tens, hundreds and thousands	b) • Exclude cases where the first non-zero digit in the answer is at the 4 th decimal place such as $0.12 \div 1000 = 0.00012$
c) solve word problems involving decimals	c) <ul style="list-style-type: none"> • Include rounding off answers to a specified degree of accuracy • Include checking reasonableness of answers

TOPICS/OUTCOMES	REMARKS
GEOMETRY	
1 ANGLES	
Pupils should be able to	
a) identify and name <ul style="list-style-type: none"> • angles on a straight line • angles at a point • vertically opposite angles 	a) <ul style="list-style-type: none"> • Exclude angles between parallel lines such as alternate angles, interior angles, corresponding angles • Exclude use of the terms ‘complementary’ and ‘supplementary’
b) recognise that angles on a straight line add up to 180° and angles at a point add up to 360°	
c) recognise that vertically opposite angles are equal	
d) find unknown angles involving <ul style="list-style-type: none"> • angles on a straight line • angles at a point • vertically opposite angles 	
2 8-POINT COMPASS	
e) tell direction in relation to the 8-point compass	
3 PROPERTIES OF A PARALLELOGRAM, A RHOMBUS, A TRAPEZIUM AND A TRIANGLE	
f) state and find unknown angles involving the properties of <ul style="list-style-type: none"> • a parallelogram • a rhombus • a trapezium 	f) <ul style="list-style-type: none"> • Exclude the term ‘diagonal’ and its related properties • Exclude additional construction of lines
g) recognise and use the property that the angle sum of a triangle is 180°	g) <ul style="list-style-type: none"> • Exclude problems where the skill of solving equations is required
h) state and find unknown angles involving the properties of <ul style="list-style-type: none"> • an isosceles triangle • an equilateral triangle • a right-angled triangle 	
i) recognise that the exterior angle of a triangle is equal to the sum of the interior opposite angles	
4 GEOMETRICAL CONSTRUCTION	
j) draw squares, rectangles, parallelograms, rhombuses and triangles from given dimensions	j) <ul style="list-style-type: none"> • Use ruler, protractor and set squares • Exclude cases where compasses are required
5 TESSELLATION	
k) recognise shapes that can tessellate	
l) identify the shape used in a tessellation	
m) make different tessellations with a given shape	
n) draw a tessellation on dot paper	

**PRIMARY 5
(EM1/EM2)**

TOPICS/OUTCOMES	REMARKS
AVERAGE, RATE AND SPEED	
1 AVERAGE	
Pupils should be able to	
a) calculate the average	
b) find the total amount given the average and the number of items	
2 RATE	
c) calculate rate	
3 WORD PROBLEMS	
d) solve up to 3-step word problems involving average and rate	

TOPICS/OUTCOMES	REMARKS
RATIO AND PROPORTION	
1 RATIO	
Pupils should be able to	
a) use ratio to show the relative sizes of <ul style="list-style-type: none"> • 2 quantities • 3 quantities 	a) <ul style="list-style-type: none"> • Introduce the sign ‘ : ’
b) interpret a given ratio <ul style="list-style-type: none"> • a : b • a : b : c 	b,c) <ul style="list-style-type: none"> • Include sums such as the following: <div style="margin-left: 20px;"> (i) $1 : 2 = \square : 8$ (ii) $2 : \square = 1 : 4$ </div>
c) recognise equivalent ratios	
d) reduce a given ratio to its lowest terms	d) <ul style="list-style-type: none"> • Include reducing a : b : c to its lowest terms
e) solve up to 2-step word problems involving ratio	

TOPICS/OUTCOMES	REMARKS
PERCENTAGES	
1 CONCEPT OF PERCENTAGE	
Pupils should be able to	
a) change fractions and decimals to percentages, and vice versa	a) <ul style="list-style-type: none"> • Include use of the percentage notation ‘%’ • Include recognising the equivalence between percentage and fraction/decimal
b) express a part of a whole as a percentage	
2 PERCENTAGE OF A QUANTITY	
c) calculate part of a whole given the percentage and the whole	
3 WORD PROBLEMS	
d) solve up to 2-step word problems involving percentage	d) <ul style="list-style-type: none"> • Exclude use of the terms ‘profit’ and ‘loss’

TOPICS/OUTCOMES	REMARKS
MENSURATION	
1 AREA AND CIRCUMFERENCE OF A CIRCLE	
Pupils should be able to	
a) identify and name the following parts of a circle: <ul style="list-style-type: none"> • centre • radius • diameter • circumference 	
b) use the formula to find <ul style="list-style-type: none"> • circumference • area 	b) <ul style="list-style-type: none"> • Include finding area and perimeter of a figure made up of the following shapes: <ul style="list-style-type: none"> (i) a semicircle (ii) a quadrant (quarter circle) (Figure should be provided)
c) solve word problems involving area and circumference of a circle	c) <ul style="list-style-type: none"> • Include use of π (to be $\frac{22}{7}$ or 3.14) • Exclude finding the radius/diameter of a circle given its area
2 AREA AND PERIMETER OF A FIGURE RELATED TO SQUARE, RECTANGLE, TRIANGLE AND CIRCLE	
d) find the area and perimeter of a figure related to the following shapes: <ul style="list-style-type: none"> • rectangle • square • triangle • circle • semicircle • quadrant 	
3 VOLUME OF A SOLID MADE UP OF CUBES/CUBOIDS AND VOLUME OF LIQUID	
e) solve word problems involving volume of <ul style="list-style-type: none"> • a solid made up of cubes and cuboids • liquid 	

TOPICS/OUTCOMES	REMARKS
STATISTICS	
1 <i>PIE CHARTS</i>	
Pupils should be able to	
a) read and interpret pie charts	a,b) • Exclude use of degrees for calculation
b) solve 1-step problems using information presented in pie charts	

TOPICS/OUTCOMES	REMARKS
GEOMETRY	
1 <i>ANGLES IN GEOMETRIC FIGURES</i>	
Pupils should be able to	
a) find unknown angles in geometric figures using the properties of <ul style="list-style-type: none"> • angles on a straight line • angles at a point • vertically opposite angles • square, rectangle, parallelogram, rhombus, trapezium and triangle 	a) • Exclude additional construction of lines
2 <i>2-D REPRESENTATION OF A 3-D SOLID</i>	
b) visualise a prism and a pyramid from drawings	b) • Include cylinder • Include the terms 'prism' and 'pyramid'
3 <i>NETS</i>	
c) identify nets of <ul style="list-style-type: none"> • a cube • a cuboid • a prism • a pyramid 	c) • Exclude net of cylinder
d) identify the solid which can be formed by a net	

**PRIMARY 6
(EM1/EM2)**

TOPICS/OUTCOMES	REMARKS
AVERAGE, RATE AND SPEED	
1 TIME (24-HOUR CLOCK)	
Pupils should be able to	
a) interpret 24-hour clock	a) <ul style="list-style-type: none"> • Include conversion between 12-hour clock and 24-hour clock, and vice versa • Include finding duration of time
2 SPEED	
b) calculate <ul style="list-style-type: none"> • speed • distance • time 	b) <ul style="list-style-type: none"> • Include use of the formula • Include activities for pupils to read, interpret and write speed in different units: km/h, m/min, m/s and cm/s • Exclude conversion of units such as 10 km/h = ? m/min, and vice versa
3 WORD PROBLEMS	
c) solve word problems involving average, rate and speed	c) <ul style="list-style-type: none"> • Exclude problems where rest time is involved in finding the average speed of a journey

TOPICS/OUTCOMES	REMARKS
RATIO AND PROPORTION	
1 RATIO AND DIRECT PROPORTION	
Pupils should be able to	
a) express one value as a fraction of another given their ratio, and vice versa	
b) find how many times one value is as large as another given their ratio, and vice versa	
c) recognise that two quantities are in direct proportion	
d) solve direct proportion problems using unitary method	
e) solve word problems on ratio and direct proportion	

TOPICS/OUTCOMES	REMARKS
PERCENTAGE	
1 ONE QUANTITY AS A PERCENTAGE OF ANOTHER	
Pupils should be able to	
a) express one quantity as a percentage of another	
b) find the whole given a part and the percentage	
c) solve word problems	c) <ul style="list-style-type: none"> • Exclude finding percentage profit/loss

TOPICS/OUTCOMES	REMARKS
ALGEBRA	
1 ALGEBRAIC EXPRESSION IN ONE VARIABLE	
Pupils should be able to	
a) use a letter to represent an unknown number and write a simple algebraic expression in one variable for a given situation	a) • Exclude expressions involving a variable in the denominator such as $\frac{1}{x}$
b) simplify algebraic expressions	b) • Exclude (i) expressions involving fractional coefficients (ii) expressions involving brackets
c) evaluate simple algebraic expressions by substitution	
d) solve word problems involving algebraic expressions	

PRIMARY 5
(EM3)

TOPICS/OUTCOMES	REMARKS
WHOLE NUMBERS	
1 NUMBER NOTATION AND PLACE VALUES	
Pupils should be able to	
a) read and write numbers up to 10 million in numerals and in words	a) • Include completing number sequences
b) compare and order numbers up to 100 000	
2 ADDITION AND SUBTRACTION	
c) add and subtract numbers up to 4 digits	c) • Include the use of the terms ‘sum’ and ‘difference’
3 MULTIPLICATION AND DIVISION	
d) multiply numbers <ul style="list-style-type: none"> • up to 4 digits by a 1-digit number • up to 3 digits by a 2-digit number 	d) • Include use of the term ‘product’
e) divide numbers <ul style="list-style-type: none"> • up to 4 digits by a 1-digit number • up to 2 digits by a 2-digit number 	e) • Include use of the terms ‘quotient’ and ‘remainder’
f) multiply and divide numbers by tens, hundreds and thousands	
4 FACTORS AND MULTIPLES	
g) determine if a 1-digit number is a factor of a given whole number	
h) list all factors of a whole number up to 100	h) • Include finding common factor of 2 numbers • Exclude finding highest common factor (H.C.F.)
i) Determine if a whole number is a multiple of a given 1-digit whole number	
j) list the first 12 multiples of a given 1-digit whole number	j) • Include finding common multiple of 2 numbers • Exclude finding lowest common multiple (L.C.M.)
5 APPROXIMATION AND ESTIMATION	
k) round off numbers to the nearest 10, 100 and 1000	k) • Include use of the approximation symbol ‘ \approx ’
l) estimate the answers in calculations involving addition, subtraction and multiplication	l) • Include checking reasonableness of answers
6 WORD PROBLEMS	
m) solve up to 3-step word problems involving whole numbers	m) • Include rounding off answers to a specified degree of accuracy

TOPICS/OUTCOMES	REMARKS
MONEY, MEASURES AND MENSURATION	
1 MONEY	
Pupils should be able to	
a) read and write money using decimal notation	
b) perform the 4 operations with money in the decimal notation	b) <ul style="list-style-type: none"> • Include making ‘change’
2 UNITS OF MEASURE	
c) use units of length and mass <ul style="list-style-type: none"> • length : kilometre, metre, centimetre • mass : kilogram, gram 	c) <ul style="list-style-type: none"> • Include visualising the relative magnitudes of standard units: <ul style="list-style-type: none"> - kilometre and metre - metre and centimetre - kilogram and gram • Include use of abbreviations: km, m, cm, kg, g
d) convert measurements of length and mass from a smaller unit of measure to a bigger unit, and vice versa	d) <ul style="list-style-type: none"> • Numbers involved should be within easy manipulation
e) perform the 4 operations with units of length and mass	e) <ul style="list-style-type: none"> • Exclude compound units
3 WORD PROBLEMS	
f) solve up to 3-step word problems involving money, length and mass	
4 AREA AND PERIMETER OF A SQUARE AND A RECTANGLE	
g) calculate the perimeter of a rectilinear figure	g) <ul style="list-style-type: none"> • Include estimating and measuring perimeter • Include finding the perimeter of a figure made up of unit squares
h) find the area of a figure drawn on square grid	
i) calculate the area and perimeter of a square and a rectangle	i) <ul style="list-style-type: none"> • Include use of abbreviations: cm² and m² • Exclude conversion between cm² and m² • Exclude compound units • Include visualising the relative size of 1 square metre and 1 square centimetre
j) find one dimension of a rectangle given the other dimension and <ul style="list-style-type: none"> • its perimeter • its area 	
k) find the side of a square given <ul style="list-style-type: none"> • its perimeter • its area 	k) <ul style="list-style-type: none"> • Exclude use of ‘$\sqrt{\quad}$’ sign
l) solve up to 3-step word problems involving area and perimeter of a square and a rectangle	l) <ul style="list-style-type: none"> • Exclude compound units

TOPICS/OUTCOMES	REMARKS
STATISTICS	
1 TABLES	
Pupils should be able to	
a) complete a table from given information	a) • Include collecting data and presenting the data in a table form
b) read and interpret tables	
2 BAR GRAPHS	
c) read and interpret bar graphs	c) • Include both horizontal and vertical representations
d) complete a bar graph from given data	
3 LINE GRAPHS	
e) read and interpret line graphs	e) • Exclude distance - time graphs
4 PROBLEMS ON STATISTICS	
f) solve problems using information given in tables, bar graphs and line graphs	

TOPICS/OUTCOMES	REMARKS
FRACTIONS	
1 CONCEPTS OF FRACTIONS	
Pupils should be able to	
a) recognise and name a fraction of a whole	
b) identify and name fractions as parts of a set of objects	
c) associate a fraction with division	
2 EQUIVALENT FRACTIONS	
d) recognise and name equivalent fractions	
e) list the first 8 equivalent fractions of a given fraction with denominator not greater than 12	
f) write the equivalent fraction of a fraction given the denominator/ numerator	
g) express a fraction in its simplest form	
3 IMPROPER FRACTIONS AND MIXED NUMBERS	
h) express an improper fraction as a mixed number, and vice versa	h) • Include expressing an improper fraction/mixed number in its simplest form
4 COMPARING AND ORDERING	
i) compare and order unlike fractions with denominators up to 12	i) • Include both increasing and decreasing order • Include use of listing of equivalent fractions • Number of fractions involved should not exceed 3

TOPICS/OUTCOMES	REMARKS
FRACTIONS	
5 ADDITION AND SUBTRACTION	
j) add and subtract fractions	<ul style="list-style-type: none"> • Include unlike fractions and mixed numbers • Include listing of equivalent fractions to identify fractions with common denominators • Denominators of given fractions should not exceed 12
6 PRODUCT OF FRACTIONS	
k) calculate the product of a proper fraction and a whole number	k,l) • Exclude mixed numbers
l) calculate the product of 2 fractions	
7 DIVISION OF A PROPER FRACTION BY A WHOLE NUMBER	
m) divide a proper fraction by a whole number	
8 WORD PROBLEMS	
n) solve up to 2-step word problems involving fractions	

TOPICS/OUTCOMES	REMARKS
DECIMALS	
1 NUMBER NOTATION AND PLACE VALUES	
Pupils should be able to	
a) read and interpret decimals up to 3 decimal places	a) <ul style="list-style-type: none"> • Include use of the number line to illustrate the concept of decimals • Include identifying the values of the digits in a decimal • Include sums such as the following: (i) $0.125 = \frac{1}{10} + \frac{2}{100} + \frac{\square}{1000}$ (ii) $0.125 = \frac{125}{\square}$ (iii) $21.203 = 21 + \frac{\square}{1000}$ • Exclude $0.125 = \frac{1}{10} + \frac{1}{50} + \frac{\square}{200}$
b) compare and order decimals	

PRIMARY 5
(EM3)

TOPICS/OUTCOMES	REMARKS
DECIMALS	
2 ADDITION AND SUBTRACTION	
c) add and subtract decimals up to 2 decimal places	
3 MULTIPLICATION AND DIVISION	
d) multiply decimals up to 2 decimal places by a whole number up to 2 digits	d) <ul style="list-style-type: none"> • Include checking reasonableness of answers
e) divide decimals up to 2 decimal places by a 1-digit whole number	e) <ul style="list-style-type: none"> • Include division of whole number by whole number with decimal answers • Include rounding off answers to 2 decimal places • Include checking reasonableness of answers
f) carry out mental calculation within the multiplication tables	
g) multiply and divide decimals up to 2 decimal places by tens, hundreds and thousands	g) <ul style="list-style-type: none"> • Exclude cases where the first non-zero digit in the answer is at the 4th decimal place such as $0.12 \div 1000 = 0.00012$
4 CONVERSION BETWEEN DECIMALS AND FRACTIONS	
h) express a decimal as a fraction, and vice versa	h) <ul style="list-style-type: none"> • Include comparing a decimal and a fraction
5 APPROXIMATION AND ESTIMATION	
i) round off decimals to <ul style="list-style-type: none"> • The nearest whole number • 1 decimal place • 2 decimal places 	i) <ul style="list-style-type: none"> • Include units of measure e.g. round off the answer correct to the nearest m, kg, etc
j) estimate the answers in calculations involving addition, subtraction and multiplication	j) <ul style="list-style-type: none"> • Include checking reasonableness of answers
6 WORD PROBLEMS	
k) solve up to 2-step word problems involving decimals	k) <ul style="list-style-type: none"> • Include rounding off answers to a specified degree of accuracy • Include checking reasonableness of answers

TOPICS/OUTCOMES	REMARKS
GEOMETRY	
1 PERPENDICULAR AND PARALLEL LINES	
Pupils should be able to	
a) identify perpendicular and parallel lines	a,b) • Include use of the terms ‘vertical’ and ‘horizontal’
b) draw perpendicular and parallel lines using ruler and set squares	
2 ANGLES IN DEGREES	
c) measure and draw angles in degrees using a protractor	c) • Include using notation such as $\angle ABC$ and $\angle x$ to name angles • Include the term ‘right angle’ • Include estimating the size of angles • Exclude use of the terms ‘acute’, ‘obtuse’ and ‘reflex’ • Exclude drawing reflex angles
d) identify and name <ul style="list-style-type: none"> • angles on a straight line • angles at a point • vertically opposite angles 	d) • Exclude angles between parallel lines such as alternate angles, interior angles, corresponding angles • Exclude use of the terms ‘complementary’ and ‘supplementary’
e) recognise that angles on a straight line add up to 180° and angles at a point add up to 360°	
f) recognise that vertically opposite angles are equal	
g) find unknown angles involving <ul style="list-style-type: none"> • angles on a straight line • angles at a point • vertically opposite angles 	
3 PROPERTIES OF A SQUARE AND A RECTANGLE	
h) state and use properties of <ul style="list-style-type: none"> • rectangle • square 	h) • Exclude the term ‘diagonal’ and its related properties • Include finding angles and sides
4 SYMMETRY	
i) recognise symmetric figures	i) • Include identifying and visualising symmetry in the environment or in designs • Exclude rotational symmetry
j) determine whether a straight line is a line of symmetry of a figure	j) • Exclude finding the number of lines of symmetry of a symmetric figure
k) complete a symmetric figure with respect to a given line of symmetry	

TOPICS/OUTCOMES	REMARKS
MONEY, MEASURES AND MENSURATION	
1 UNITS OF MEASURE	
Pupils should be able to	
a) use units of time and volume time : hour, minute, second, day, week, month, year volume of liquid : litre, millilitre	a) <ul style="list-style-type: none"> • Include visualising the relative magnitudes of standard units <ul style="list-style-type: none"> - hour and minute - minute and second - year and month - year and day - month and day - week and day - litre and millilitre • Include the use of abbreviations: <i>ℓ</i>, ml, h, min, s
b) find the duration of time interval	
c) convert measurements of time and volume of liquid from a smaller unit of measure to a larger unit, and vice versa	
d) perform the 4 operations with units of time and volume of liquid	d) <ul style="list-style-type: none"> • Exclude compound units
e) solve up to 3-step word problems involving time and volume of liquid	e) <ul style="list-style-type: none"> • Include problems involving concept of duration of time interval, e.g. find duration of time, find starting time or arrival time
2 AREA AND PERIMETER	
f) calculate the area and perimeter of <ul style="list-style-type: none"> • a triangle • figure related to square, rectangle and triangle 	f) <ul style="list-style-type: none"> • Include identifying the base and its corresponding height • Exclude compound units
g) solve up to 3-step word problems involving area and perimeter of squares, rectangles and triangles	g) <ul style="list-style-type: none"> • Exclude compound units • Exclude finding the base or height of a triangle given its area

TOPICS/OUTCOMES	REMARKS
MONEY, MEASURES AND MENSURATION	
3 VOLUME OF CUBE / CUBOID AND LIQUID	
h) find volume of solids made up of unit cubes	
i) calculate the volume of a cube, a cuboid and liquid in cubic centimetres/cubic metres	i) <ul style="list-style-type: none"> • Include use of abbreviations: cm^3, m^3, ℓ, ml • Include finding volume of liquid in a rectangular container • Include recognising the following equivalents: <div style="margin-left: 20px;"> $1 \ell = 1000 \text{ cm}^3$ $1 \text{ cm}^3 = 1 \text{ ml}$ </div> • Include conversions between ℓ, ml and cm^3 • Exclude conversion between m^3 and cm^3 • Exclude compound units • Include visualising the relative size of 1 cubic metre and 1 cubic centimetre
j) find one dimension of a cuboid given its volume and the other two dimensions	j) <ul style="list-style-type: none"> • Exclude use of the term ‘area of a face’
k) find the edge of a cube given its volume	k) <ul style="list-style-type: none"> • Exclude use of ‘$\sqrt[3]{\quad}$’ sign
l) solve up to 3-step word problems involving volume	l) <ul style="list-style-type: none"> • Include problems involving the height of water level in rectangular tank • Exclude finding volume of solid by the volume of liquid displaced

TOPICS/OUTCOMES	REMARKS
STATISTICS	
1 PIE CHARTS	
Pupils should be able to	
a) read and interpret pie charts	a,b) <ul style="list-style-type: none"> • Exclude use of degrees for calculation
b) solve 1-step problems using information presented in pie charts	

TOPICS/OUTCOMES	REMARKS
GEOMETRY	
1 PROPERTIES OF TRIANGLES	
Pupils should be able to	
a) identify and name the following triangles: <ul style="list-style-type: none"> • isosceles • equilateral • right-angled 	a) <ul style="list-style-type: none"> • Exclude use of the terms ‘scalene’, ‘acute’ and ‘obtuse’
b) recognise and use the property that the angle sum of a triangle is 180°	b) <ul style="list-style-type: none"> • Exclude problems where the skill of solving equations is required
c) state and find unknown angles involving the properties of <ul style="list-style-type: none"> • an isosceles triangle • an equilateral triangle • an right-angled triangle 	
2 ANGLES IN GEOMETRIC FIGURES	
d) find unknown angles in geometric figures using the properties of <ul style="list-style-type: none"> • angles on a straight line • angles at a point • vertically opposite angles • a square, a rectangle and a triangle 	
3 GEOMETRICAL CONSTRUCTION	
e) draw a square, a rectangle and a triangle from given dimensions	e) <ul style="list-style-type: none"> • Include providing a sketch of the figure to be constructed • Use ruler, protractor and set squares • Exclude cases where compasses are required

TOPICS/OUTCOMES	REMARKS
AVERAGE AND RATE	
1 AVERAGE	
Pupils should be able to	
a) calculate the average	
b) find the total amount given the average and the number of items	
2 RATE	
c) calculate rate	
3 WORD PROBLEMS	
d) solve up to 3-step word problems involving average and rate	

TOPICS/OUTCOMES	REMARKS
DIRECT PROPORTION	
1 DIRECT PROPORTION	
Pupils should be able to	
a) recognise that two quantities are in direct proportion	
b) solve direct proportion problems using the unitary method	
c) solve up to 3-step word problems on direct proportion	

TOPICS/OUTCOMES	REMARKS
PERCENTAGE	
1 CONCEPT OF PERCENTAGE	
Pupils should be able to	
a) change fractions and decimals to percentages, and vice versa	a) <ul style="list-style-type: none"> • Include use of the percentage notation ‘%’ • Include recognising the equivalence between percentage and fraction/decimal
b) express a part of a whole as a percentage	
2 PERCENTAGE OF A QUANTITY	
c) calculate part of a whole given the percentage and the whole	
d) calculate discount given its percentage	d) <ul style="list-style-type: none"> • Exclude finding percentage discount
3 WORD PROBLEMS	
e) solve up to 3-step word problems involving percentage	e) <ul style="list-style-type: none"> • Include problems involving discount • Exclude use of the terms ‘profit’ and ‘loss’ • Exclude finding the whole given a part and the percentage • Exclude finding percentage increase/decrease and percentage profit/loss • Exclude expressing one quantity as a percentage of another

Definitions of Suggested Thinking Skills

- **Classifying**
Using relevant attributes to sort, organise and group information
- **Comparing**
Using common attributes to identify commonalities and discrepancies across numerous sets of information
- **Sequencing**
Placing items in a hierarchical order according to a quantifiable value
- **Analysing Parts and Whole**
Recognising and articulating the parts that together constitute a whole
- **Identifying Patterns & Relationships**
Recognising the specific variations between two or more attributes in a relationship that yields a reliable or repeated scheme
- **Induction**
Drawing a general conclusion from clues gathered (from specific to general)
- **Deduction**
Inferring various specific situations or examples from given generalisations (from general to specific)
- **Spatial Visualisation**
Visualising a situation or an object and mentally manipulating various alternatives for solving a problem related to situation or object without benefit of concrete manipulatives

Use of Abacus for Addition and Subtraction

1. Structure of the Abacus

- (a) An abacus is a calculating instrument. It consists of a number of counting beads that slide up and down the column rods.
- (b) A horizontal bar divides the abacus into two parts. The upper part consists of 5-unit beads and the lower part consists of 1-unit beads. Each 5-unit bead has a 'face value' of 'five' and each 1-unit bead has a 'face value' of 'one'.
- (c) Each column has a place value 10 times the place value of the column on its right.

2. General Rule for Manipulating Beads

- (a) Always use the thumb to push up the lower beads. This is the only time the thumb is used. It never goes above the bar.
- (b) Always use the forefinger to push down the lower beads.
- (c) Always use the forefingers to push up the upper beads.
- (d) When displaying numbers 6 to 9, slide the 1-unit bead(s) with the thumb and the 5-unit bead with the forefinger at the same time.

3. Use of Abacus For Addition And Subtraction

When using the abacus to add or subtract numbers, we may have to subtract while adding or add while subtracting. Therefore, in learning to use the abacus for addition and subtraction, both addition and subtraction should be learnt at the same time. There are altogether five basic skills and one further skill of manipulating the beads for addition and subtraction. They are:

1. **Skill A**
This is the most fundamental skill of using the 1-unit beads, 5-unit bead or both together for addition and subtraction. There are 35 cases each.
2. **Skill B**
In adding or subtracting 1, 2, 3 or 4, when there are not enough 1-unit beads to use on the column, you have to make use of the 5-unit bead. There are 10 cases each for addition and subtraction.
3. **Skill C**
In adding or subtracting 5, 6, 7, 8, or 9, when there are not enough 1-unit beads and 5-unit bead to use on the column, you have to make use of beads on the left column. There are 25 cases each for addition and subtraction.
4. **Skill D**
In adding or subtracting 1, 2, 3 or 4, when there are not enough 1-unit beads and 5-unit bead to use on the column, you have to make use of beads on the left column. There are 10 cases each for addition and subtraction.

5. **Skill E**
This is a combination of Skill B and Skill C. There are 10 cases each for addition and subtraction.
6. **Further Skill**
Addition and subtraction involving multiple steps.

Suggested References

1. Billstein, Rick. (1987). *A Problem Solving Approach to Maths for Elementary School Teachers*. 3rd ed. Benjamin/Cummings Pub. Co.
2. Burns, Marilyn. (1976). *The Book of Think & How to solve a Problem Twice Your Size*. Boston, Little, Brown & Co.
3. Carne, Barnett S. (1982). *Teaching Kids Maths (Problem-Solving Activities), To help Young Children Learn and Enjoy Maths*. Prentice Hall.
4. Charles, R and Lester, F. (1984). *Teaching Problem Solving*. London, Edward Arnold.
5. Compiled. (1987) *Bright Ideas: Maths Activities*. Scholastic Publications.
6. Fields, Joyce I. (1993). *The Challenge Ahead-Information Technology in the Primary School Curriculum*. Harwood Academic Publishers.
7. Heimann, M. (1987). *Teaching Thinking Skills: Mathematics*. NEA Professional Library. National Education Association.
8. Holt, B. (1982). *Mathematical Activities: A Resource Book for Teachers*. Cambridge University Press.
9. Krulik, S. and Rudnick, J. (1988). *Problem Solving: A Handbook for Elementary School Teachers*. Allyn & Bacon.
10. Leone, Burton. (1984). *Thinking Things Through: Problem Solving in Mathematics*. Basil Blackwell Ltd.
11. Marzano, Robert J., et al. (1992). *Dimensions of Learning-Teacher's Manual*. Association for Supervision and Curriculum Development. Mid-continent Regional Educational Laboratory.
12. Mckim, Robert, H. M. and Belmont. (1980). *Experiences in Visual Thinking*. Brooks/Cole Publishing Co.
13. Mottershead, L. (1985). *Investigations in Mathematics*. Basil Blackwell Ltd.
14. NCTM. (1971). *Experiences in Mathematical Discovery: Mathematical Thinking*, National Council of Teachers of Mathematics.
15. NCTM. (1980). *Problem Solving in School Mathematics, 1980 Yearbook*.
16. NCTM. (1986). *Estimation and Mental Computation, 1986 Yearbook*.
17. NCTM. (1987). *Learning and Teaching Geometry, K 12, 1987 Yearbook*.
18. Polya, G. (1981). *Mathematical Discovery: On Understanding, Learning and Teaching Problem Solving*. N. Y. Wiley.
19. Reys, Robert E. (1989). *Helping Children Learn Maths*. 2nd ed. Englewood Cliffs, Prentics Hall.
20. Schminke, C.W. (1985). *Math Activities for Child Involvement*. 4th ed. Pro - Ed.

21. Sharaga Yeshurun. (1979). *The Cognitive Method: A Strategy for Teaching Word Problems*. NCTM.
22. Stacey and Kaye. (1985). *Strategies for Problem Solving: Lesson Plans for Developing Mathematical Thinking*. Victoria College Press. 1985.
23. Swartz, Robert J. and Parks, Sandra. (1994). *Infusing Critical and Creative Thinking into Content Instruction*. Critical Thinking Press & Software. 1994.