Grade

9 Mathematics

Teachers' Guide

(Implemented from year 2018)

Department of Mathematics
Faculty of Science & Technology
National Institute of Education
Maharagama, Sri Lanka.

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Message of the Director General

With the primary objective of realizing the National Educational Goals recommended by the National Education Commission, the then prevalent content based curriculum was modernized, and the first phase of the new competency based curriculum was introduced to the eight year curriculum cycle of the primary and secondary education in Sri Lanka in the year 2007

The second phase of the curriculum cycle thus initiated was introduced to the education system in the year 2015 as a result of a curriculum rationalization process based on research findings and various proposals made by stake holders.

Within this rationalization process the concepts of vertical and horizontal integration have been employed in order to build up competencies of students, from foundation level to higher levels, and to avoid repetition of subject content in various subjects respectively and furthermore, to develop a curriculum that is implementable and student friendly.

The new Teachers' Guides have been introduced with the aim of providing the teachers with necessary guidance for planning lessons, engaging students effectively in the learning teaching process, and to make Teachers' Guides will help teachers to be more effective within the classroom. Further, the present Teachers' Guides have given the necessary freedom for the teachers to select quality inputs and activities in order to improve student competencies. Since the Teachers' Guides do not place greater emphasis on the subject content prescribed for the relevant grades, it is very much necessary to use these guides along with the text books compiled by the Educational Publications Department if, Guides are to be made more effective.

The primary objective of this rationalized new curriculum, the new Teachers' Guides, and the new prescribed texts is to transform the student population into a human resource replete with the skills and competencies required for the world of work, through embarking upon a pattern of education which is more student centered and activity based.

I wish to make use of this opportunity to thank and express my appreciation to the members of the Council and the Academic Affairs Board of the NIE the resource persons who contributed to the compiling of these Teachers' Guides and other parties for their dedication in this matter.

Dr. (Mrs.) Jayanthi Gunasekara
Director General
National Institute of Education
Maharagama

Message of the Deputy Director General

Education from the past has been constantly changing and forging forward. In recent years, these changes have become quite rapid. Past two decades have witnessed a high surge in teaching methodologies as well as in the use of technological tools and in the field of knowledge creation.

Accordingly, the National Institute of Education is in the process or taking appropriate and timely steps with regard to the education reforms of 2015.

It is with immense pleasure that this Teachers' Guide where the new curriculum has been planned based on a thorough study of the changes that have taken place in the global context adopted in terms of local needs based on a student-centered learning-teaching approach, is presented to you teachers who serve as the pilots of the schools system.

An instructional manual of this nature is provided to you with the confidence that, you will be able to make a greater contribution using this.

There is no doubt whatsoever that this Teachers' Guide will provide substantial support in the classroom teaching-learning process at the same time. Furthermore the teacher will have a better control of the classroom with a constructive approach in selecting modern resource materials and following guide lines given in this book.

I trust that through the careful study of this Teachers Guide provided to you, you will act with commitment in the generation of a greatly creative set of students capable of helping Sri Lanka move socially as well as economically forward.

This Teachers' Guide is the outcome of the expertise and unflagging commitment of a team of subject teachers and academics in the field Education.

While expressing my sincere appreciation of this task performed for the development of the education system, my heartfelt thanks go to all of you who contributed your knowledge and skills in making this document such a landmark in the field.

M.F.S.P. Jayawardhana
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Pictures:	Try outing the lesson plans in schools of Western and North-western Provinces

Instructions on the use of the Teacher's Guide

The Department of Mathematics of the National Institute of Education has been preparing for the new education reforms to be implemented in 2015 for the first time since 2007, in accordance with the education reforms policy which is implemented once every eight years. The Grade 9 Mathematics Teacher's Guide which has been prepared accordingly has many special features.

The **Grade 9 syllabus** is included in the first chapter. The syllabus has been organized under the titles Competencies, Competency Levels, Content, Learning Outcomes and Number of Periods. The proposed **lesson sequence** is given in the second chapter. The **Learning-Teaching-Evaluation methodology** has been introduced in the third chapter. A special feature of this is that the best method to develop each of the subject concepts in students has been identified from various methods such as the discovery method, the guided discovery method, the lecture-discussion method etc and the lesson plan has been developed based on it.

Following the proposed lesson sequence, the relevant competency and competency levels as well as the number of periods required for each lesson have been included at the beginning under each topic. Specimen lesson plans have been prepared with the aim of achieving one or two of the learning outcomes related to a selected competency level under each competency. These lesson plans have been carefully prepared to be implemented during a period or a maximum of two periods.

To create awareness amongst the students regarding the practical applications of the subject content that is learnt, a section titled '**Practical Use'** which contains various such applications has been introduced in some of the lessons.

You have been provided with the opportunity to prepare suitable lesson plans and appropriate assessment criteria for the competency levels and related learning outcomes for which specimen lesson plans have not been included in this manual. Guidance on this is provided under the title '**For your attention** ….'.

Another special feature of this Teacher's Guide is that under each lesson, websites which can be used by the teacher or the students, in the classroom or outside which contain resources that include videos and games to enhance students' knowledge is given under the title '**For further use'** and the symbol  **.** Although it is not essential to make use of these, the learning-teaching-evaluation process can be made more successful and students' subject knowledge can be enhanced by their use, if the facilities are available.

Further, in selected lessons, under the title "**For the teacher only**" and the symbol  , facts which are especially for the teacher are included. This information is only to enhance the teacher's knowledge and is not given to be discussed with the students directly. The teacher has the freedom to make necessary amendments to the specimen lesson plan given in the new teacher's manual which includes many new features, depending on the classroom and the abilities of the students. We would be grateful if you would send any amendments you make or any new lessons you prepare to the Director, Department of Mathematics, National Institute of Education. The mathematics department is prepared to incorporate any new suggestions that would advance mathematics educations in the secondary school system.

Project Leader

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1.0 Syllabus

1.1 Common National Goals

The national system of education should assist individuals and groups to achieve major national goals that are relevant to the individual and society.

Over the years major education reports and documents in Sri Lanka have set goals that sought to meet individual and national needs. In the light of the weaknesses manifest in contemporary educational structures and processes, the National Education Commission has identified the following set of goals to be achieved through education within the conceptual framework of sustainable human development.

I Nation building and the establishment of a Sri Lankan identity through the promotion of national cohesion, national integrity, national unity, harmony and peace, and recognizing cultural diversity in Sri Lanka's plural society within a concept of respect for human dignity.

II Recognizing and conserving the best elements of the nation's heritage while responding to the challenges of a changing world.

III Creating and supporting an environment imbued with the norms of social justice and a democratic way of life that promotes respect for human rights, awareness of duties and obligations, and a deep and abiding concern for one another.

IV Promoting the mental and physical well-being of individuals and a sustainable life style based on respect for human values.

V Developing creativity, initiative, critical thinking, responsibility, accountability and other positive elements of a well-integrated and balance personality.

VI Human resource development by educating for productive work that enhances the quality of life of the individual and the nation and contributes to the economic development of Sri Lanka.

VII Preparing individuals to adapt to and manage change, and to develop capacity to cope with complex and unforeseen situations in a rapidly changing world.

VIII Fostering attitudes and skills that will contribute to securing an honourable place in the international community, based on justice, equality and mutual respect.

1.2 Common National Competencies

The following Basic Competencies developed through education will contribute to achieving the above National Goals.

(I) Competencies in Communication

Competencies in Communication are based on four subsets; Literacy, Numeracy, Graphics and IT proficiency.

Literacy: Listen attentively, speak clearly, read for meaning, write accurately and lucidly and communicate ideas effectively.

Numeracy: Use numbers for things, space and time, count, calculate and measure systematically.

Graphics: Make sense of line and form, express and record details, instructions and ideas with line form and colour.

IT proficiency: Computer literacy and the use of information and communication technologies (ICT) in learning, in the work environment and in personal life.

(II) Competencies relating to Personality Development

- Generic skills such as creativity, divergent thinking, initiative, decision making, problem solving, critical and analytical thinking, team work, inter-personal relations, discovering and exploring;
- Values such as integrity, tolerance and respect for human dignity;
- Emotional intelligence.

(III) Competencies relating to the Environment

These competencies relate to the environment: social, biological and physical.

Social Environment: Awareness of the national heritage, sensitivity and skills linked to being members of a plural society, concern for distributive justice, social relationships, personal conduct, general and legal conventions, rights, responsibilities, duties and obligations.

Biological Environment: Awareness, sensitivity and skills linked to the living world, people and the ecosystem, the trees, forests, seas, water, air and life- plant, animal and human life.

Physical Environment: Awareness, sensitivity and skills linked to space, energy, fuels, matter, materials and their links with human living, food, clothing, shelter, health, comfort, respiration, sleep, relaxation, rest, wastes and excretion.

Included here are skills in using tools and technologies for learning working and living.

(IV) Competencies relating to Preparation for the World of Work

Employment related skills to maximize their potential and to enhance their capacity

- to contribute to economic development,
- to discover their vocational interests and aptitudes,
- to choose a job that suits their abilities, and
- to engage in a rewarding and sustainable livelihood.

(V) Competencies relating to Religion and Ethics

Assimilating and internalizing values, so that individuals may function in a manner consistent with the ethical, moral and religious modes of conduct in everyday living, selecting that which is most appropriate.

(VI) Competencies in Play and the Use of Leisure

Pleasure, joy, emotions and such human experiences as expressed through aesthetics, literature, play, sports and athletics, leisure pursuits and other creative modes of living.

(VII) Competencies relating to “learning to learn”

Empowering individuals to learn independently and to be sensitive and successful in responding to and managing change through a transformative process, in a rapidly changing, complex and interdependent world.

1.3 Aims of Learning Mathematics

The following objectives should be aimed at and achieved to further develop the mathematical concepts, creativity and sense of appreciation in students entering the junior secondary stage, so that their mathematical thinking, understanding and abilities are formally enhanced.

(1) The development of computational skills through the provision of mathematical concepts and principles, as well as knowledge of mathematical operations, and the development of the basic skills of solving mathematical problems with greater understanding.

(2) The development of correct communication skills by enhancing the competencies of the proper use of oral, written, pictorial, graphical, concrete and algebraic methods.

(3) The development of connections between important mathematical ideas and concepts, and the use of these in the study and improvement of other subjects. The use of mathematics as a discipline that is relevant to lead an uncomplicated and satisfying life.

(4) The enhancement of the skills of inductive and deductive reasoning to develop and evaluate mathematical conjectures and conversations.

(5) The development of the ability to use mathematical knowledge and techniques to formulate and solve problems, both familiar and unfamiliar and which are not limited to arithmetic or the symbolical or behavioral, which arise in day to day life.

2.4 Subject Content

Competency	Competency Level	Content	Learning Outcomes	Periods
Competency – 1 Manipulates the mathematical operations in the set of real numbers to fulfill the needs of day to day life.	**1.1** Organizes numbers in ways that facilitate their manipulation.	• Scientific notation • Large numbers (Up to a million) • Decimal numbers	• Identifies writing a number as the product of a number greater or equal to 1 and less than 10, and a power of ten as representing a number in scientific notation. • Writes numbers greater than one in scientific notation. • Writes numbers less than one in scientific notation.	03
	1.2 Determines approximate values to facilitate manipulation.	• Rounding off • Whole numbers (Up to the millions period) • To the nearest 10 • To the nearest 100 • To the nearest 1000 • Decimal numbers (To a given decimal place)	• Identifies the rules that are used when rounding off numbers. • Rounds off whole numbers to the nearest ten. • Rounds off whole numbers to the nearest hundred. • Rounds off whole numbers to the nearest thousand. • Rounds off a decimal number to a given decimal place. • Solves problems related to rounding off.	02
	1.3 Develops relationships between numbers in different bases.	• Binary numbers • Introduction • Conversion • Base two ⇔ Base ten • Addition	• Identifies binary numbers. • Converts a binary number into a decimal number. • Converts a decimal number into a binary number. • Adds binary numbers. • Subtracts binary numbers. • Investigates instances in the modern world where	03

Competency	Competency Level	Content	Learning Outcomes	Periods
		• Subtraction	the binary number system is used.	
Competency – 2 Makes decisions for future requirements by investigating the various relationships between numbers.	**2.1** Develops the general term by identifying the relationship between the terms of a number pattern.	• General term • Of a given number pattern	• Writes the general term of a number pattern. • Writes the number pattern when its general term is given. • Solves problems related to number patterns.	03
Competency – 3 Manipulates units and parts of units under the mathematical operations to easily fulfill the requirements of day to day life.	**3.1** Methodically simplifies expressions involving fractions.	• Simplifying fractions • Laws of simplification (BODMAS)	• Simplifies expressions of fractions that contain "of". • Accepts that the laws on the order in which simplification should be carried out (BODMAS) need to be followed when simplifying fractions under the basic mathematical operations. • Simplifies expressions of fractions that contain brackets. • Simplifies expressions of fractions that contain the basic mathematical operations, brackets and "of". • Solves problems involving fractions by applying the BODMAS Laws.	05
Competency – 4 Uses ratios to facilitate day to day activities.	**4.1** Engages in calculations by considering direct	• Introducing direct proportions • Problems related to direct proportions	• Identifies proportion • Explains direct proportions using examples. • Writes the relationship between two quantities which are directly proportional in the form $y = kx$.	06

Competency	Competency Level	Content	Learning Outcomes	Periods
	proportions.	• Unitary method • Based on the definition of proportion • Foreign currency • Representing direct proportions algebraically • $x \propto y \rightarrow x = ky$; k is a constant • $y \propto x \rightarrow y = kx$ • Solving problems using $x = ky$	• Solves problems related to direct proportions by applying the unitary method. • Solves problems related to direct proportions by using the definition of proportion. • Solves problems involving the conversion of foreign currency by applying the knowledge on direct proportions. • Solves problems on direct proportions by expressing the relationship algebraically.	
Competency - 5 Uses percentages to make successful transactions in the modern world.	**5.1** Makes decisions by comparing profits and losses.	• Profit, Loss • Uses of percentages (Discounts, Commissions)	• Identifies the profit/loss. • Identifies the profit/loss percentage. • Performs calculations related to purchase price, selling price, profit/loss percentage. • Explains what a discount is. • Performs calculations related to discounts. • Explains what a commission is. • Performs calculations related to commissions. • Solves problems by applying the knowledge on profit/loss/discounts/commissions.	06
Competency – 6 Uses logarithms and calculators to easily solve problems in day	**6.1** Simplifies powers by applying the laws of indices.	• Laws of indices • Multiplication • Division • Power of a power	• Identifies the laws of indices that are applied when multiplying powers and dividing powers • Identifies the laws of indices that are applied when finding the power of a power.	03

Competency	Competency Level	Content	Learning Outcomes	Periods

to day life.		• Simplifying indices
		  • Including zero index
		  • Including negative indices
			• Recognizes that $a^0 = 1$ and $a^{-n} = \frac{1}{a^n}$.
			• Applies the laws of indices to simplify expressions involving indices.	

	6.2
	Uses the calculator to facilitate calculations.
		• Scientific calculator
		  • Using the keys of a calculator
		  • =, %, x^2, $\sqrt{x}$
			• 1. Identifies the keys On , Off, +, -, ×, ÷ and = in the scientific calculator
			• Uses scientific calculator using the keys On , Off, +, -, ×, ÷ and =
			• Identifies the keys %, x^2 and $\sqrt{x}$ in the scientific calculator.
			• Uses the keys %, x^2 and $\sqrt{x}$ in the scientific calculator.
			• Accepts that efficiency can be increased by using the scientific calculator.
			• Check the accuracy of the answers by using the scientific calculator.
				02

Competency – 7
Investigates the various methods of finding the perimeter to carry out daily tasks effectively.
	7.1
	Applies the relationship between the diameter and circumference of a circle when performing various calculations.
		• Circle
		  • Measuring the diameter
		  • Measuring the circumference
		  • Relationship between the circumference and the diameter
		  • Application of the formulae $c = \pi d$ and $c = 2\pi r$
			• Measures the diameter and the circumference of circular laminas using various methods.
			• Develops a formula for the circumference by considering the relationship between the diameter and the circumference of a circle.
			• Performs calculations related to the circumference of a circle by applying the formulae $c = \pi d$ and $c = 2\pi r$.
			• Finds the circumference of a circle.
			• Finds the perimeter of a semi-circle.
			• Solves simple problems involving the circum-ference of a circle.
				05

Competency	Competency Level	Content	Learning Outcomes	Periods
		• Perimeter of a semi-circle		
Competency – 8 Makes use of a limited space in an optimal manner by investigating the area.	**8.1** Investigates the area of simple geometrical shapes in the environment.	• Area • Parallelogram • Trapezium • Circle	• Develops a formula for the area of a parallelogram. • Finds the area of a parallelogram. • Develops a formula for the area of a trapezium. • Finds the area of a trapezium. • Develops the formula $A = \pi r^2$ for the area A of a circle. • Performs calculations by applying the formula $A = \pi r^2$. • Solves problems related to the areas of parallelograms, trapeziums and circles.	05
Competency – 11 Works critically with the knowledge on liquid measures to fulfill daily needs.	**11.1** Develops relationships between units of liquid measurements.	• Relationships between the units of liquid measurements • Milliliter and cubic centimeter • Liter and cubic centimeter • Liter and cubic meter	• Identifies the relationship between ml and cm^3. • Develops the relationship between l and cm^3. • Develops the relationship between l and m^3. • Converts liquid measurements in one unit to another, by using the relationships between ml and cm^3, between l and cm^3, and between l and m^3. • Solves problems related to the conversion of units of liquid measurements.	03
Competency – 13 Uses scale diagrams in practical situations by	**13.1** Indicates the direction of a location by means of an	• Location of a place • By means of "bearing"	• Explains "bearing". • Accepts that the bearing and the distance are needed to describe the location of a place with respect to another place on a horizontal plane.	05

Competency	Competency Level	Content	Learning Outcomes	Periods
exploring various methods.	angle.		• Identifies the clinometer as an instrument that is used to measure bearing and uses it. • Describes various locations in terms of bearing and distance. • Performs calculations related to bearing.	
	13.2 Investigates various locations in the environment using scale diagrams.	• Two dimensional scale diagrams • On a horizontal plane	• Draws scale diagrams of locations in a horizontal plane when the relevant bearings and distances are given. • Obtains measurements in relation to locations in a horizontal plane using scale diagrams.	03
Competency – 14 Simplifies algebraic expressions by systematically exploring various methods.	**14.1** Simplifies expressions by substitution.	• Algebraic expressions • Substitution (without roots but including fractions)	• Finds the value of an algebraic expression which does not involve powers or roots by substituting directed numbers.	02
	14.2 Simplifies binomial expressions	• Simplification • Algebraic expressions with brackets • Of the form $a(x \pm y) + b(x \pm y)$, where $a, b \in \mathbb{Z}$. • Of the form, $(x \pm a)(x \pm b)$, where	• Simplifies algebraic expressions involving binomial expressions which are of the form $a(x \pm y) + b(x \pm y)$, where $a, b \in \mathbb{Z}$. • Simplifies algebraic expressions of the form $(x \pm a)(x \pm b)$, where $a, b \in \mathbb{Z}$. • Validates the product of two binomial expressions using areas.	03

Competency	Competency Level	Content	Learning Outcomes	Periods
		$a, b \in \mathbb{Z}$.		

Competency – 15 Factorizes algebraic expressions by systematically exploring various methods.	**15.1** Presents algebraic expressions in a simple form by factorizing.	• Factors of algebraic expressions
		  • The common factor a binomial expression; up to 4 terms
		  • Of the form $ax + ay + cx + cy$
		  • Of the form $x^2 + ax + bx + ab$
			• Factorizes an algebraic expression with up to four terms by taking two terms at a time.
			• Factorizes an algebraic expression with four terms, where the factors are binomial expressions.
				02

	15.2 Factorizes quadratic expressions to fulfill mathematical requirements.	• Trinomial quadratic expressions of the form $x^2 + bx + c$ • Difference of two squares (not including algebraic expressions)	• Organizes an algebraic expression of the form $x^2 + bx + c$ into a form that can be factored, by separating the x term into two terms. • Factorizes an algebraic expression of the form $x^2 + bx + c$. ($b, c \in \mathbb{Z}$, with $b^2 - 4c$ a perfect square) • Writes down the factors of the difference of two squares that includes algebraic terms.	03

Competency - 16 Explores the various methods of simplifying algebraic fractions to solve problems encountered in day to day life.	**16.1** Analyses relationships in daily life by simplifying algebraic fractions.	• Algebraic fractions
		  • Introduction
		  • Addition and subtraction
		  • With integral denominators
			• Identifies algebraic fractions.
			• Adds and subtracts algebraic fractions with equal integral denominators.
			• Adds and subtracts algebraic fractions with unequal integral denominators.
			• Adds and subtracts algebraic fractions with equal
				03

Competency	Competency Level	Content	Learning Outcomes	Periods
		(equal/unequal denominators) • With algebraic denominators (equal denominators)	algebraic denominators.	
Competency – 17 Manipulates the methods of solving equations to fulfill the needs of day to day life.	**17.1** Easily solves problems in day to day life by solving linear equations.	• Solving linear equations • With two types of brackets • With fractions	• Solves linear equations containing algebraic terms with fractional coefficients. • Solves linear equations with two types of brackets.	03
	17.2 Solves problems by using the methods of solving simultaneous equations.	• Solving simultaneous equations • The coefficient of one unknown being of equal numerical value in the two equations	• Solves a pair of simultaneous equations by eliminating an unknown, when the coefficient of one unknown is of equal numerical value in both equations. • Uses other algebraic methods to solve pairs of simultaneous equations when the coefficient of one unknown is of equal numerical value in both equations. • Selects the most suitable method to solve a pair of simultaneous equations.	03
Competency – 18 Analyzes the relationships between various quantities related	**18.1** Uses the relationship between two quantities to	• Solving inequalities • Of the form $x \pm a \gtrless b$ $(a, b \in \mathbb{Z})$	• Solves inequalities of the form $x \pm a \gtrless b$ $(a, b \in \mathbb{Z})$. • Solves inequalities of the form $ax \gtrless b$ when $a > 0$. • Solves inequalities of the form $ax \gtrless b$ when $a < 0$.	03

Competency	Competency Level	Content	Learning Outcomes	Periods
to real-life problems.	solve problems.	• Of the form $ax \gtrless b$ $(a \neq 0)$ • Representation of the solutions on a number line • Integral solutions • Intervals of solutions	($a \neq 0$. a is an integer or a fraction) • Represents the integral solutions of an inequality on a number line. • Represents the solutions of an inequality on a number line.	
Competency – 19 Explores the methods by which formulae can be applied to solve problems encountered in day to day life.	**19.1** Changes the subject of a formula that has been developed to show the relationship between variables.	• Changing the subject of simple formulae (Without squares and square roots) • Substitution	• Changes the subject of a formula that does not contain squares and square roots. • Performs calculations by substituting values for the unknowns in a simple formula.	02
Competency – 20 Easily communicates the mutual relationships that exist between two variables by	**20.1** Analyses graphically mutual linear relationship between two variables.	• Introducing functions • Straight line graphs • Of the form $y = mx$ • Of the form $y = mx + c$ • Of the form	• Identifies that the relationship between x and y given by a linear equation in x and y is a function. • Draws the graph of a function of the form $y = mx$. • Draws the graph of a function of the form $y = mx + c$. • Explains how the graph of a function changes	04

Competency	Competency Level	Content	Learning Outcomes	Periods
exploring various methods.		$ax + by = c$ (for a given domain) • Introducing the gradient and the intercept	depending on the sign and magnitude of the gradient m. • States that m is the gradient and c is the intercept of the graph of a function of the form $y = mx + c$. • Writes down the gradient and the intercept of the graph of a function of the form $y = mx + c$ by examining the function. • Draws the graph of a function of the form $ax + by = c$ for a given domain. • Analyses the gradients of straight line graphs which are parallel to each other.	
Competency – 21 Makes decisions by investigating the relationships between various angles.	**21.1** Establishes the relationships between the angles related to straight lines.	• Application of the theorem "The sum of the adjacent angles formed by a straight line meeting another straight line is two right angles" (Proof not expected) • Proof and application of the theorem "If two straight lines intersect one another, the vertically opposite angles are equal"	• Identifies the theorem "The sum of the adjacent angles formed by a straight line meeting another straight line is two right angles". • Verifies the theorem "The sum of the adjacent angles formed by a straight line meeting another straight line is two right angles". • Solves problems by applying the theorem "The sum of the adjacent angles formed by a straight line meeting another straight line is two right angles". • Identifies the theorem "If two straight lines intersect one another, the vertically opposite angles are equal". • Verifies the theorem "If two straight lines intersect one another, the vertically opposite angles are equal".	03

Competency	Competency Level	Content	Learning Outcomes	Periods
			• Solves problems by applying the theorem "If two straight lines intersect one another, the vertically opposite angles are equal". • Proves the theorem "If two straight lines intersect one another, the vertically opposite angles are equal".	
	21.2 Investigates the angles formed by various intersecting straight lines.	• The angles formed when a transversal intersects a pair of straight lines • Alternate angles • Corresponding angles • Allied angles	• Identifies the alternate angles, corresponding angles and allied angles that are formed when a transversal intersects a pair of straight lines.	01
	21.3 Identifies the relationships between the angles related to parallel lines.	• Application of the following theorem and its converse; "When a transversal intersects a pair of straight lines, if a pair of alternate angles is equal, or a pair of corresponding angles is equal or the sum of a pair of allied angles equals two right angles, then the pair of straight lines is	• Identifies the theorem, "When a transversal intersects a pair of straight lines, if a pair of alternate angles is equal, or a pair of corresponding angles is equal or the sum of a pair of allied angles equals two right angles, then the pair of straight lines is parallel" • Verifies the theorem, "When a transversal intersects a pair of straight lines, if a pair of alternate angles is equal, or a pair of corresponding angles is equal or the sum of a pair of allied angles equals two right angles, then the pair of straight lines is parallel"	03

Competency	Competency Level	Content	Learning Outcomes	Periods
		parallel" (Proof not expected)	• Solves problems by applying the theorem, "When a transversal intersects a pair of straight lines, if a pair of alternate angles is equal, or a pair of corresponding angles is equal or the sum of a pair of allied angles equals two right angles, then the pair of straight lines is parallel" • Identifies the following converse of the above theorem, "When a transversal intersects a pair of parallel straight lines, - pairs of alternate angles formed are equal - pairs of corresponding angles formed are equal - the sum of each pair of allied angles formed equals two right angles. • Verifies the following converse of the above theorem, "When a transversal intersects a pair of parallel straight lines, - pairs of alternate angles formed are equal - pairs of corresponding angles formed are equal - the sum of each pair of allied angles formed equals two right angles. • Solves problems by applying the following converse of the above theorem, "When a transversal intersects a pair of parallel straight lines, - pairs of alternate angles formed are equal - pairs of corresponding angles formed are equal - the sum of each pair of allied angles formed	

Competency	Competency Level	Content	Learning Outcomes	Periods
			equals two right angles.	
Competency – 23 Makes decisions regarding day to day activities based on geometrical concepts related to rectilinear plane figures.	**23.1** Geometrically analyses the relationships between quantities.	• Introducing axioms through geometry • Quantities that are equal to the same quantity are equal to each other • If equal quantities are added to equal quantities, the resultant quantities will also be equal • If equal quantities are subtracted from equal quantities, the resultant quantities will also be equal • If equal quantities are multiplied by equal quantities the resultant quantities will be equal • If equal quantities are divided by equal quantities, the resultant quantities will be equal	• Identifies the five basic axioms. • Develops relationships using the five basic axioms.	04

Competency	Competency Level	Content	Learning Outcomes	Periods
	23.2 Formally investigates the sum of the three interior angles of a triangle.	• Application of the theorem "The sum of the three interior angles of a triangle is 180^{o}"	• Identifies the theorem, "The sum of the three interior angles of a triangle is 180^{o}". • Verifies the theorem, "The sum of the three interior angles of a triangle is 180^{o}". • Solves simple geometric problems using the theorem, "The sum of the three interior angles of a triangle is 180^{o}".	04
	23.3 Investigates the relationship between the exterior angle formed by producing a side of a triangle and the interior opposite angles.	• Application of the theorem "If a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles"	• Identifies the theorem, "If a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles". • Verifies the theorem, "If a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles". • Solves simple geometric problems using the theorem, "If a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles".	04
	23.4 Performs calculations using the sums of the interior and exterior angles of a polygon.	• Application of the theorem "The sum of the interior angles of an n-sided polygon equals $(2n - 4)$ right angles" • Application of the theorem	• Identifies the theorem, "The sum of the interior angles of an n-sided polygon equals $(2n - 4)$ right angles". • Verifies the theorem, "The sum of the interior angles of an n-sided polygon equals $(2n - 4)$ right angles". • Solves simple geometric problems using the theorem, "The sum of the interior angles of an n-sided polygon equals $(2n - 4)$ right angles".	05

Competency	Competency Level	Content	Learning Outcomes	Periods
		"The sum of the exterior angles of an *n*-sided polygon is four right angles"	• Identifies the theorem, "The sum of the exterior angles of an *n*-sided polygon is four right angles". • Verifies the theorem, "The sum of the exterior angles of an *n*-sided polygon is four right angles". • Solves simple geometric problems using the theorem, "The sum of the exterior angles of an *n*-sided polygon is four right angles".	
	23.5 Applies Pythagoras' relationship to solve problems in day to day life.	• Identifying and applying Pythagoras' relationship (For whole number values)	• Identifies Pythagoras' relationship. • Verifies Pythagoras' relationship. • Solves simple problems by applying Pythagoras' relationship. • Solves problems in day to day life by applying the subject content related to Pythagoras' relationship.	04

Competency – 27 Analyzes according to geometric laws, the nature of the locations in the surroundings.	**27.1** Uses the knowledge on the basic loci to determine the location of a point.	• Introducing the basic loci
		  • The locus of a point moving at a constant distance from a fixed point
		  • The locus of a point moving at an equal distance from two fixed points
		  • The locus of a point moving at a constant distance from a straight line
			• Identifies what a locus is.
			• Identifies the four basic loci.
			• Constructs a perpendicular to a straight line from a point on the line.
			• Constructs a perpendicular to a straight line from an external point.
			• Constructs a perpendicular to a straight from an end point.
			• Constructs the perpendicular bisector of a straight line.
			• Solves problems in day to day life by using the knowledge on the basic loci.
				05

Competency	Competency Level	Content	Learning Outcomes	Periods

		• The locus of a point moving at an equal distance from two intersecting straight lines. (without constructions)
		• Construction of a line perpendicular to a straight line
		  • From an external point
		  • From a point on the line
		  • From an end point
		  • Perpendicular bisector		

	27.2 Uses geometric constructions in various activities.	• Bisection of an angle • Construction of 60^o, 90^o, 30^o, 45^o, 120^o • Copying an angle equal to a given angle • Construction of parallel lines	• Constructs the bisector of an angle. • Constructs angles of magnitude 60^o, 30^o, 120^o. • Constructs angles of magnitude 90^o, 45^0. • Constructs other angles that can be constructed using the construction of angles of magnitude 60^o, 90^o, 30^o, 45^o, 120^o. • Studies methods of validating the accuracy of the constructions.	04

Competency – 28
Facilitates daily work by investigating the
	28.1
	Represents data such that comparison is
		• Representation of data
		  • In tables
		  • Ungrouped
			• Identifies a frequency distribution.
			• Presents a given group of data in a frequency distribution without class intervals.
				04

Competency	Competency Level	Content	Learning Outcomes	Periods
various methods of representing data.	facilitated.	frequency distribution (clustering without class intervals) • Grouped frequency distribution	• Identifies what a class interval is. • Identifies presenting data in class intervals as grouping data. • Represents a given group of data in a frequency distribution with class intervals.	
Competency – 29 Makes predictions after analyzing data by various methods, to facilitate daily activities.	**29.1** Investigates frequency distributions using representative values.	• Interpretation of data • Measures of central tendency of an ungrouped frequency distribution • Mode • Median • Mean • Measures of dispersion of an ungrouped frequency distribution • Range • Grouped frequency distribution • Modal class • Median class	• Identifies the central tendency measurements of mode, median and mean as representative values of a frequency distribution. • Identifies the score that occurs the most in a group of data as the mode of that group. • Identifies the score in the middle of a group of data when it is in either ascending or descending order as the median of that group. • Identifies the value that is obtained when the values of all the data are added together and divided by the number of data as the mean of that group. • Calculates the mean of a group of data using the formula $\bar{x} = \frac{\Sigma fx}{\Sigma f}$, when it has been presented in a frequency distribution. • Identifies the difference between the greatest value and the least value of a group of data as its range. • Identifies grouped frequency distributions. • Writes down the modal class of a grouped frequency distribution. • Writes down the median class of a grouped frequency distribution.	06

Competency	Competency Level	Content	Learning Outcomes	Periods
			• Makes decisions in day to day life by considering representative values.	

Competency – 30
Manipulates the principles related to sets to facilitate daily activities.
	30.1
	Performs set operations by identifying various systems.
		• Types of sets
		  • Finite sets
		  • Infinite sets
		• Relationship between two sets
		  • Subsets of a set
		  • Equal sets
		  • Equivalent sets
		  • Disjoint sets
		  • Universal set
		• Set Operations
		  • Intersection
		  • Union
		  • Complement of a set
			• Identifies finite sets and infinite sets.
			• Concludes with reasons whether a given set is a finite set or an infinite set.
			• Writes down all the subsets of a given set.
			• Explains the difference between equivalent sets and equal sets.
			• Identifies disjoint sets.
			• Identifies the universal set.
			• Writes down the elements in the intersection of two sets.
			• Writes down the elements in the union of two sets.
			• Identifies the complement of a set.
			• Identifies the symbols relevant to set operations.
			• Accepts that if the intersection of two sets is the empty set, then the two sets are disjoint.
			• Solves problems using the knowledge on sets.
			• Represents subsets, the intersection of two sets, the union of two sets, disjoint sets and the complement of a set in Venn diagrams and writes these sets using the symbols used for set operations. (For two sets only)
				07

Competency – 31 Analyzes the likelihood of an event occurring to predict future	**31.1** Investigates the likelihood of an event by considering the	• Randomness • Sample space • Probability of an event A in a sample space	• Identifies random experiments. • Identifies the set of all possible outcomes of an experiment as the sample space of that experiment. • Writes down the sample space of a given	05

Competency	Competency Level	Content	Learning Outcomes	Periods
events.	outcomes of the experiment.	S when the outcomes are equally likely $P(A) = \frac{n(A)}{n(S)}$	experiment. • Identifies equally likely outcomes. • Writes down examples of equally likely outcomes. • Performs calculations using the formula $P(A) = \frac{n(A)}{n(S)}$ for an event A of a random experiment with equally likely outcomes, having a sample space S. • Makes decisions in day to day life using the knowledge gained on probability.	
			Total	142

Lesson Sequence

Contents	Competency Levels	Number of periods
1st Term		
1. Round off and Scientific Notation	1.1, 1.2	05
2. Number base two	1.3	03
3. Number Patterns	2.1	03
4. Fractions	3.1	05
5. Percentages	5.1	06
6. Algebraic Expressions	14.1, 14.2	05
7. Factors of the algebraic expressions	15.1, 15.2	05
8. Angles related to strait lines and parallel lines	21.1, 21.2, 21.3	07
9. Liquid Measurements	11.1	03
		42
2nd Term		
10. Direct proportion	4.1	06
11. Calculator	6.2	02
12. Indices	6.1	03
13. Loci and Constructions	27.1, 27.2	09
14. Equations	17.1, 17.2	06
15. Axioms	23.1	04
16. Angles of a triangle	23.2, 23.3	09
17. Formulae	19.1	02
18. Circumference of a circle	7.1	05
19. Pythagoras relationship	23.5	04
20. Graphs	20.1	04
		54
3rd Term		
21. Inequalities	18.1	03
22. Sets	30.1	07
23. Area	8.1	05
24. Probability	31.1	05
25. Angles of polygons	23.4	05
26. Algebraic fractions	16.1	03
27. Scale drawings	13.1, 13.2	08
28. Data representation and prediction	28.1, 29.1	10
		46
26		**Total 142**

1. Rounding off and Scientific Notation

Competency 1: Manipulates the mathematical operations in the set of real numbers to fulfill the needs of day to day life.

Competency Level 1.1: Organizes numbers in ways that facilitate their manipulation

Number of Periods: 03

Introduction:

- Scientific notation is used as a method of indicating large numbers (e.g. 5 900 000 000 which is the distance to the pluto from the sun in kilometres) and small numbers (e.g. 0. 000 000 000 753 which is the mass of an sand atom in kilorams) in shortened form.
- In scientific notation , the relevant numbers (1 or greater than 1 or less than 10) are written as a product of a number and a power of 10.
- Any fraction that can be indicated as terminating or recurring decimals and integers belong to the set of rational numbers.
- When A is a number (1 or greater than 1 but less than 10) and n is an integer , the scientific notation is indicated in generalised form by $A \times 10^n$.
- This section expects to direct students to write large numbers greater 1 and small numbers less than 1 by scientific notation.

Learning outcomes relevant to Competency Level 1.1:

1. Identifies writing a number as the product of a number greater or equal to 1 and less than 10, and a power of ten as representing a number in scientific notation.
2. Writes numbers greater than one in scientific notation.
3. Writes numbers less than one in scientific notation.

Glossary of terms:

Integes	- නිඛිල	- நிறைவெண்கள்
Power	- බලය	- வலு
Scientific notation	- විද්‍යාත්මක අංකනය	- விஞ்ஞானமுறைக் குறிப்பீடு

Instructions to plan the lesson:

A specimen lesson that would adopt guided inquiry method to develop in students the first and second learning outcomes relevant to competency level 1.1 is given below.

Time: 40 minutes

Quality inputs:

- The demy paper containing the information in Annex I
- Copies of Annex I , one for each student.

Instructions for the teacher:

Approach:

- Distribute the copies of Annex I to the students
- Show the demy paper containing the information in Annex I to the students.
- Engage the students in the activity of completing the table 1.1 in the annex and revise their Knowledge about 1 and the numbers greater than 1 and less than 10.

Development of the lesson:

- Using the examples such as those given below , show how a number can be shown in terms of powers of ten.

  $30 = 3 \times 10 = 3 \times 10^1$

  $300 = 3 \times 100 = 3 \times 10^2$

- Reinforce students' knowledge by getting them to complete table 1.2 , given in the annex.
- After completing table 1.2, establish in students the idea that a number can be represented by the product of either 1 or a number greater than but less than 10 and a power of 10 and that this is called scientific notation.
- Also draw students' attention to the relationship between the change in the decimal place and the power of 10.

Assessment and evaluation:

- Assessment criteria:
  - Identifies scientific notation as a method of abbreviating large numbers.
  - Writes large numbers given in the scientific notation.
  - Accepts that writing large numbers in the scientific notation is easier. .
  - Engages correctly in the activity following the instructions given.
  - Works cooperatively within the group.
- Direct the students to do the relevant exercises in lesson 1 of the textbook.

For your attention...

Development of the lesson:

- Discuss with students about writing the numbers less than one by scientific notation in relation to the learning outcome 3.

- Explain the writing of numbers below 1 by scientific notation presenting examples such as follows.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 1 of the text book.

$$0.7 = \frac{7}{10} = 7 \times \frac{1}{10} = 7 \times 10^{-1}$$

$$0.12 = \frac{12}{100} = \frac{12}{10} + \frac{1}{10} = 1.2 \times 10^{-1}$$

$$0.0352 = \frac{3.52}{100} = 3.52 \times \frac{1}{100} = 3.52 \times 10^{-2}$$

For further reference:

- http://www.youtube.com/watch?v=cK1egPBjJXE
- http://www.youtube.com/watch?v=OPxzx75bAfk
- http://www.youtube.com/watch?v=DaoJmvqU3FI
- http://www.youtube.com/watch?v=pf41fDSWeoA
- http://www.youtube.com/watch?v=3jBfLaLrk6I
- http://www.youtube.com/watch?v=_qzs1zozTBo
- http://www.youtube.com/watch?v=fh8gkPW_6g4
- http://www.youtube.com/watch?v=BkwI6Uu0vi4

http://www.youtube.com/watch?v=_MIn3zFkEcc

Annex I

Table 1.1

Of the following numbers, select either 1 or numbers greater than 1 but less than 10 and underline them.

0.1, 9.2, 8.32, 10.1, 0.9, 1.0, 2.35, 8.09

Table 1.2

Complete the blanks.

4	4×1	4×10^0
40	4×10	4×10^1
400	4×100	$4 \times$ ☐
4000	$4 \times$ ☐	☐ $\times 10^3$
40000	☐ $\times 10000$	$4 \times$ ☐
☐	4×100000	☐ $\times$ ☐
52	$5.2 \times$ ☐	☐ $\times 10^1$
638	$\times 100$	☐ $\times$ ☐

Table 1.3

Complete the blanks.

Number	Scientific notation
5	☐ $\times 10^0$
52	$5.2 \times$ ☐
502	☐ $\times 10^2$
173	$1.73 \times$ ☐
6072	☐ $\times 10^3$
4807	☐ $\times$ ☐
☐	5.31×10^3

2. Binary Numbers

Competency 1: Manipulates the mathematical operations in the set of real numbers to fulfill the needs of day to day life.

Competency Level 1.3: Develops relationships between numbers in different bases.

Number of Periods: 03

Introduction:

- The number system written using only the two digits 0 and 1 is referred to as the number system to base two or the binary number system.
- The digits used in the number system to the base two are only 0 and 1.
- When writing binary numbers it is a must that the base is written as two.
  e.g. 11_{two}
- As in the case of the number system to the base 10, the place value is expressed by the powers of 10 , in the number system to the base two , the place value is indicated by the powers of two as 2^0, 2^1, 2^2, ...
- Numbers to the base two can be represented by the abacus and maximum number of counting objects in a rod of it can be one.
- Numbers to the base ten can be converted to numbers to base two by repeated division by two until the quotient is zero.
- In a binary number, by finding the values according to place value, binary numbers can be converted to numbers to base ten.
- $0_{two} + 0_{two} = 0_{two}$ $\quad$ $0_{two} - 0_{two} = 0_{two}$

  $0_{two} + 1_{two} = 1_{two}$ $\quad$ $10_{two} - 1_{two} = 1_{two}$

  $1_{two} + 0_{two} = 1_{two}$ $\quad$ $1_{two} - 0_{two} = 1_{two}$

  $1_{two} + 1_{two} = 10_{two}$ $\quad$ $1_{two} - 1_{two} = 0_{two}$

  By using above bonds, addition and subtraction of binary numbers can be done.
- The devices such as calculators and computers in the modern world use base two numbers.

Learning outcomes relevant to Competency Level 2.3:

1. Identifies binary numbers.
2. Converts a decimal number into a binary number.
3. Converts a binary number into a decimal number.
4. Adds binary numbers.
5. Subtracts binary numbers.
6. Investigates instances in the modern world where the binary number system is used.

Glossary of terms:

Base	-	පාදය	-	அடி
Place Value	-	ස්ථානීය අගය	-	இடப்பெறுமானம்
Binary numbers	-	ද්විමය සංඛ්‍යා	-	துவித எண்கள்
Conversion	-	පරිවර්තනය	-	மாற்றல்

Instructions to plan the lesson:

Given below is a specimen lesson that incorporates a group activity planned to achieve the learning outcomes 1 and 2 relating to the competency level 1.3.

Time: 40 minutes

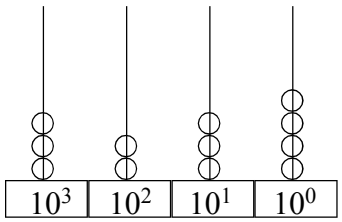
Quality inputs:

- Tooth picks or small pieces of eakles, 25 for each group
- Rubber bands or twine
- Halfsheets
- Copies of the activity sheet

Instructions for the teacher:

Approach:

- Through a discussion with students, emerge the fact that 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 are the digits that are being used in the presently used system of numbers of base ten.
- Using the abacus , explain the value of the respective digits in the number 3234 written using those numbers.



$3\times10^3 + 2\times10^2 + 3\times10^1 + 4\times10^0$

$3000 + 200 + 30 + 4$

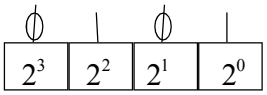
3234

- Stress that the maximum number of counting objects that can be accommodated by a single rod in the abacus is 9.
- Recall that not putting any counting objects to a rod of the abacus indicates 0.
- State that likewise there can be other number bases as well.
- Recall that numbers such as 1, 2, 4, 8, 16, ... can be written as powers of 2 as follows.

  $1 = 2^0$, $2 = 2^1$, $4 = 2^2$, $8 = 2^3$

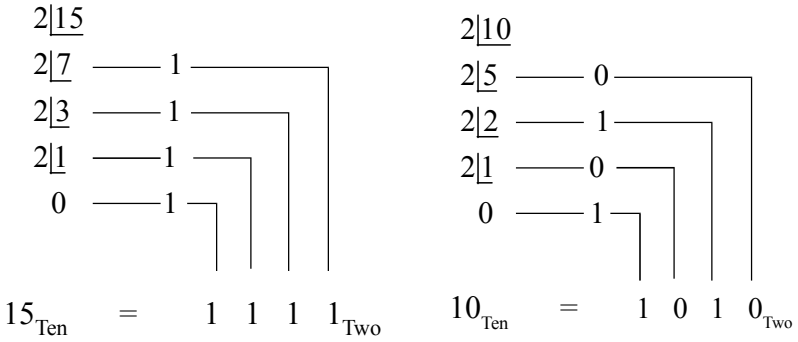
Development of the lesson:

- Divide the class into groups as appropriate.
- Distribute quality inputs and activity sheets among the students.
- Give instructions to engage in the activity and record the results individually while discussing within the group.
- Assess students while moving with the groups and helping them when necessary.
- Introduce numbers to the base two to the students using examples in the activity.
- Explain how the binary numbers are represented in the abacus.



$- \quad 1 \quad 0 \quad 1 \quad 0_{Two}$

- Build up the whole surfacing the students' findings and how a number to the base ten is converted to a number of base two by repeated division till the quotient is zero.



$15_{Ten} = 1 \quad 1 \quad 1 \quad 1_{Two}$ $10_{Ten} = 1 \quad 0 \quad 1 \quad 0_{Two}$

Activity sheet for the Students :

Group	Relevant numbers
A	9, 12
B	11,14
C	15, 20

- Take pieces of eakles equal to the first number you have received.
- Using rubber bands, make bundles of two pieces of eakles in each. If there are single pieces keep them aside.
- Tie up into bundles of twos again the two-eakle bundles. If any two eakle bundles are left, keep them aside.
- If possible tie up the four-eakle bundles in pairs. If any four-eakle bundles are left, keep them aside.

- Using the results of your activity, complete the following table. If there are no relevant bundles put 0

Bundles of 8	Bundles of 4	Bundles of 2	Bundles of 1
-------	------	------	------

Number of pieces of eakles you got = -- of 8 + -- of 4 + -- of 2 + -- of 1

---------- = 8 ×---- + 4 ×---- + 2 ×---- + 1 ×----

------ $_{\text{Ten}}$ =

8	4	2	1
---	---	---	---

-------- =

$2^{\square}$	$2^{\square}$	$2^{\square}$	$2^{\square}$
---	---	---	---

- Do the same activity for the second number you have got and write the result as above.

Assessment and evaluation:

- Assessment criteria:
  - Indicates a number to the base two as a sum of the powers of 2.
  - Identifies the number system with 0 and 1 as the number system of base ten.
  - Describes the value of a number to the base 2 in terms of the place value.
  - Indicates a base ten number in base two.
  - Accepts that in calculators and computers base two is used.
- Direct the students to do the relevant exercises in lesson 2 of the textbook.

Practical situations:

- Discuss with the students that base two is used in calculators and computers.

For your attention.....

Development of the lesson:

- After the establishment of learning outcomes 1 and 2 relevant to the competency level 1.3 in students, they may be involved in the following joyful game.
- Make five cards as shown in the diagram and write those numbers in the cards.
- Let students think of a number below 31.

- Give 5 cards to a students and ask to separate the cards which bear the number he has thought.
- If he says that number is seen in cards 1, 2, 4 say that the number is 1+2+4 = 7
- When the students become aware of the game, let them play the game in pairs.
- Say that this game can be played for other number bases as well.

16	8	4	2	1
17	8	4	2	1
17	9	5	3	3
18	10	6	6	5
19	11	7	7	7
20	12	12	10	9
21	13	13	11	11
22	14	14	14	13
23	15	15	15	15
24	24	20	18	17
25	25	21	19	19
26	26	22	22	21
27	27	23	23	23
28	28	28	26	25
29	29	29	27	27
30	30	30	30	31
31	31	31	31	

- Taking the place value in to consideration, make students aware of writing the numbers in base two in the number base of ten.
- Remembering well the additive and subtractive bounds in base two, practice addition and subtraction of binary numbers.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 2 of the text book.

For further reference:

•

3. Number Patterns

Competency 2 : Makes decisions for future requirements by investigating the various relationships between numbers.

Competency Level 2.1: Develops the general term by identifying the relationship between the terms of a number pattern.

Number of Periods: 03

Introduction:

- By identifying the relationship between the terms of some number patterns, there is a possibility of obtaining the other terms in the pattern. These number patterns are called as number sequences.
- The general term of a number pattern is decided by the value of each term of the number pattern, the place of the term and the relationship between the successive terms. In grade 8, students have learnt the general term in natural numbers, odd numbers, triangular numbers, square numbers and multiples.
- Under the competency level 2.1 in grade 9, students are expected to find out the general term in any number pattern in which the difference between any two successive terms is equal.

Learning outcomes relevant to Competency Level 2.1:

1. Writes the general term of a number pattern.
2. Writes the number pattern when its general term is given.
3. Solves problems related to number patterns.

Glossary of terms:

Number sequence	- සංඛ්‍යා අනුක්‍රම	- எண் தொடரி
n^{th} term	- n වන පදය	- n ஆம் உறுப்பு
1^{st} term	- පළමු පදය	- முதலாம் உறுப்பு
Difference of terms	- පද අතර වෙනස	- உறுப்புக்களுக்கிடை யேயானவித்தியாசம்
General term	- සාධාරණ පදය	- பொது உறுப்பு

Instructions to plan the lesson:

This aims to build up in students the subject concepts relating to the learning outcome 1 under the competency level 2.1. For this, a specimen lesson planned to make students build up the general term of a given pattern using the guided inquiry method is presented below.

Time: 40 minutes

Quality inputs:

- Copies of the activity sheet, one for each student

Instruction for the teacher:

Approach:

- Display a number pattern with multiples learned in grade 8 on the board and recall how the general term was found.
- Ask students about the difference between the first term and the successive terms in a given number pattern of equal difference of terms.
- In order to obtain the general term of this number pattern, conduct a discussion about the make of the first term and second term.
- On that basis, make a review with regard to the finding out of the general term of a number pattern in which the difference between the successive term is equal.

Development of the lesson:

- Group the students as appropriate, give one copy of the activity sheet to each group and engage them in the activity.
- After completion of the activity, give an opportunity for students to present how they discovered the general term of the pattern.
- Conduct a discussion explaining to the students that the general term of the pattern can be easily built up in relation to the difference between successive terms.

Activity sheet for the Students:

In the number pattern 4, 7, 10, 13, ...

- What is the first term?
- What is the difference between two successive terms? .....
- In order to obtain a general term using the first term and the difference between two successive terms in the above pattern, fill in the following blanks.

$1s^t$ term $\Rightarrow$ 4 = $4 + 3 \times 0$
2^{nd} term $\Rightarrow$ 7 = 4 + ... $\times$ 1
3^{rd} term $\Rightarrow$ 10 = ... + ... $\times$ .....
4^{th} term $\Rightarrow$ 13 = ... + ... $\times$ .....
5^{th} term $\Rightarrow$ ..... = ... + ... $\times$ .....
8^{th} term $\Rightarrow$ ..... = ... + ... $\times$ .....
10^{th} term $\Rightarrow$ ..... = ... + ... $\times$ .....
n^{th} term $\longrightarrow$ ..... + ... $\times$ .....
= ..... + 3 *(n - 1)*
= .....
= _____

- Obtained a general term for the nth term in the following pattern as was done above.

Group A	4, 9, 14, 19, ...
Group B	2, 5, 8, 11, ...
Group C	3, 7, 11, 15, ...
Group D	8, 11, 14, 17, ...

- Write two uses of obtaining the general term.

Assessment and evaluation:

- Assessment criteria:
  - Writes the initial term and the difference between the successive terms of the number pattern.
  - Builds up the relationship between the terms in the number pattern.
  - Writes the general term of any number pattern in which the difference between successive terms is equal.
  - Seeks relationships reviewing information.
  - acts cooperatively within the group.
- Direct the students to do the relevant exercises in lesson 3 of the textbook.

For your attention...

Development of the lesson:

- Design and implement activities suitable for obtaining the terms and solve the problems related to number patterns when the general term is given in relation to the learning outcomes 2 and 3.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 3 of the text book.

For further reference:

- http://www.youtube.com/watch?v=Muba9-W2FOQ
- http://www.youtube.com/watch?v=HXg_a9oJ5nA
- http://www.youtube.com/watch?v=KSrnZMAfwTM
- http://www.youtube.com/watch?v=mFftY8Y_pyY
- https://www.youtube.com/watch?v=Zj-a_9cd5jc

4. Fractions

Competency 3 : Manipulates units and parts of units under the mathematical operations to easily fulfill the requirements of day to day life.

Competency Level 3.1: Methodically simplifies expressions involving fractions.

Number of Periods: 05

Introduction:

In an expression in which either whole numbers or fractions are connected by mathematical operations , each of those operations are effected in a certain sequence. The sequence in which those mathematical operations are placed in the expression is always not the sequence that should be followed when simplifying it. The verbal description of the expression brings into view the order of working out the mathematical operations. In grade 7 students have learnt how to find the value of an expression in which whole numbers are combined by basic mathematical operations.

When solving problems with fractions, the students should know how to manipulate brackets and "of" when they are coupled with the mathematical operations ÷, ×, + and - . So, in the simplification of fractions, the following order should be followed.

1. Simplifying the part within the brackets
2. Simpliifying the part with "of"
3. Operating division
4. Operating multiplication
5. Operating addition
6. Operating subtraction

The rule that indicates the sequence of operation when simplifying fractional numbers according to basic mathematical operations along with brackets and 'of' is known as 'BODMAS'. This section aims to develop the ability of simplifying fractions using the 'BODMAS' rule.

Learning outcomes relevant to Competency Level 3.1:

1. Simplifies expressions of fractions that contain "of".
2. Accepts that the laws on the order in which simplification should be carried out (BODMAS) need to be followed when simplifying fractions under the basic mathematical operations.
3. Simplifies expressions of fractions that contain brackets.
4. Simplifies expressions of fractions that contain the basic mathematical operations, brackets and "of".
5. Solves problems involving fractions by applying the BODMAS Law.

Glossary of terms:

Fractions	- භාග	- கணிதச் செய்கைகள்
Brackets	- වරහන්	- அட்சரகணித உறுப்பு
Division	- බෙදීම	- அட்சரகணிதக் கோவை
Multiplication	- ගුණ කිරීම	- கூற்று
Addition	- එකතු කිරීම	- அடைப்பு
Subtraction	- අඩු කිරීම	- தெரியாக்கணியம
Mathematical Operation	- ගණිත කර්ම	- கணிதச் செய்கைகள்

Instructions to plan the lesson:

Given below is a specimen lesson designed to develop in students the forth learning outcome adopting guided inquiry method with teacher demonstration after reinforcing in them the subject concepts relevant to learning outcomes 1, 2 and 3 under the competency level 3.1.

Time: 40 minutes

Instructions for the teacher:

Approach:

- Identify the knowledge gained by students about fractions in the former classes and start the lesson with an inquiry into the simplification of fractions
- Discuss with students about the solving of problems $2 \div \left(\frac{1}{4} \times \frac{1}{5} \right)$ and $2 \div \frac{1}{4} \times \frac{1}{5}$
- Discuss with students about the difference in the values of answers obtained for the above problems.
- Through it elicit from students the need of a sequence for solving problems relating to fractions.

Development of the lesson:

- Using an example, explain to students that arbitrary use of brackets doesn't lead to identical answers when simplifying fractions using several mathematical operations.
- Emphasize to students, that in an instance of a simplification involving the mathematical operations ÷ and ×, it has to be decided which operation is worked out first.
- Simplify some examples such as the ones given below while discussing with students. In each, draw students attention to the content within brackets.

(1) $\left(\frac{1}{2}+\frac{1}{3}\right)\times\frac{1}{4}$

(First simplifying part within brackets.)

(2) $\frac{2}{5}\div\frac{1}{3}\times\frac{3}{4}$

(Simplify × and ÷ from left to right respectively)

(3) $\frac{2}{5}\div\frac{1}{3}$ *of* $\frac{3}{4}$

(First simplify the part with 'of"

(4) $\frac{1}{2}-\frac{1}{3}+\frac{1}{4}$

(Simplify + and - from left to right respectively)

(5) $\frac{1}{2}+\frac{1}{3}\times\frac{1}{4}$

(If there are × or ÷ and + or - , first × or ÷ and then + or - should be simplified)

- Accordingly make the students understand that a sequence is essential in the simplifications related to fractions which include brackets, 'of' and basic mathematical operations. Recall them the folowing order.

  Step (1) Simplifying the part with brackets

  Step (2) Simplifying the part with 'of"

  Step (3) Using the mathematical operation division

  Step (4) Using the mathematical operation multiplication

  Step (5) Using the mathematical operation addition

  Step (6) Using the mathematical operation subtraction

Assessment and evaluation:

- Assessment criteria:
  - Accepts the need of an order in the multiplication of mathematical operation when simplifying expressions with fractions that include basic mathematical operations.
  - Simplifies expressions with fractions within brackets.
  - Simplifies expressions with fractions that include + and - from left to right respectively.
  - Simplifies expressions with fractions that includes ÷ and × from left to right respectively.
  - Simplifies expressions with fractions that include basic mathematical operations, brackets and 'of' using the BODMAS rule.
- Direct the students to do the relevant exercises in lesson 4 of the textbook.

For your attention...
Development of the lesson:

- Plan and implement suitable lessons to develop in students abilities relevant to the learning outcomes 5 under competency level 3.1.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 4 of the text book.

For further reference:

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5. Percentage

Competency 5 : Uses percentages to make successful transactions in the modern world.

Competency Level 5.1: Makes decisions by comparing profits and losses.

Number of Periods: 06

Introduction:

• In trade, always the seller tries to sell a good at a price greater than the buying price of it. Then the seller gets a profit. But in some instances it has to be sold at a price less than that spent for buying it. Then the merchant suffers a loss. The profit or loss can be calculated by the difference between the buying price and the selling price. It is easier to make decision about the more profitable transactions by indicating the profit or loss as a percentage.

• With the hope of attracting consumers, in many trade activities, the goods are sold at a price less than the price marked on them. By this, more profit can be earned by the increased sales. The amount of the price reduced in such occasions is known as the **discount** and it is indicated as a percentage of the marked price.

• When selling high valued items such as a land or a vehicle or when selling some goods in stocks, the service of a middleman is sought. Such a person is called broker. The amount paid to the broker for his service is called the **commission**. This is indicated as a percentage of the amount obtained by the relevant act of trade.

Learning outcomes relevant to Competency Level 5.1:

1. Identifies the profit/loss.
2. Identifies the profit/loss percentage.
3. Performs calculations related to purchase price, selling price, profit/loss percentage.
4. Explains what a discount is.
5. Performs calculations related to discounts.
6. Explains what a commission is.
7. Performs calculations related to commissions.
8. Solves problems by applying the knowledge on profit/loss/discounts/ commissions.

Glossary of terms:

Profit/Loss	- ලාභය/අලාභය	- இலாபம் / நட்டம்
Purchase price	- ගත්මිල	- கொள்விலை
Selling price	- විකුණුම් මිල	- விற்றவிலை
Marked price	- ලකුණු කළ මිල	- குறித்த விலை
Discount	- වට්ටම	- கழிவு
Commission	- කොමිස්	- தரகு (கமிஷன்)
Broker	- තැරැව්කරුවා	- தரகர்

Instructions to plan the lesson:

Given below is a specimen lesson that adopts lecture-discussion method and an individual activity aimed at developing subject matter related to the learning outcomes 1, 2 and 3 under the competency level 5.1.

Time: 40 minutes

Quality inputs:

- Copies of the activity sheet

Instructions for the teacher:

Approach:

- Display some newspaper advertisement and posters with the words profit, loss, discount, commission in the classroom and discuss about the profits and losses as instances where percentages are used in trade.
- Write a few fractions on the board and discuss how they are written as percentages recalling previous knowledge.

Development of the lesson:

- Presenting each of the following instances verbally, ask students about the profit /loss incurred in rupees.

1. Selling for Rs. 100 an item bought for Rs. 80
2. Selling for Rs. 95 an item bought for Rs. 80
3. Selling for Rs. 150 an item bought for Rs. 120
4. Selling for Rs. 150 an item bought for Rs. 115
5. Selling for Rs. 2080 an item bought for Rs. 1350
6. Selling for Rs. 2150 an item bought for Rs. 1500
7. Selling for Rs. 900 an item bought for Rs. 960

- Discuss that a profit is resulted when purchase price < selling price and a loss is incurred when purchase price > selling price and the profit/loss can be formed by the difference between the purchase price and the selling price.
- Discuss with students that from transactions 1 and 2 , 1 is profitable and from transactions 3 and 4, 4 is profitable.
- Discuss that case 5 and 6, such a comparison cannot be made on the basis of percentages.
- Give an opportunity for students to complete the activity sheet individually and discuss about the calculation of the percentages of profits and losses. Emphasize that here, profit / loss should be written as a fraction of the purchase price.

Activity sheet for the Students :

- Copy the following table and complete it.

Item	Purchasing price (Rs.)	Selling price(Rs.)	Profit /loss	$\frac{Profit\ /\ loss}{Purchase\ price}$	Percentage of profit /loss
A	80	100	20	$\frac{20}{80}$	$\frac{20}{80} \times 100\% = 25\%$
B	80				
C	80				
D	80				
E	80				

(i) What are the occasions of getting the same percentage?
(ii) According to the percentage of the profit ,by what item the highest profit is obtained?

Assessment and evaluation:

- Assessment criteria:
  - Finds profit/loss when purchase price and selling price are known.
  - Calculate the percentage of profit/loss.
  - States that when calculating the percentage of profit /loss, the profit/loss should be written as a fraction of the purchase price.
  - Decides on the more profitable trade on the basis of the percentage.
  - Contributes to the discussion of relevant facts with others while actively engaging in the activity

- Direct the students to do the relevant exercises in lesson 5 of the textbook.

For your attention...

Development of the lesson:

- Orient to exercises presenting examples on finding the profit/loss and selling price when the percentage of profit/ loss and purchase price are given.
- Reinforce the relevant subject matter following suitable methods for the other learning outcomes as well.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 5 of the text book.

For further reference:

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6. Algebraic Expressions

Competency 14 : Simplifies algebraic expressions by systematically exploring various methods.

Competency Level 14.1: Simplifies expressions by substitution.

Competency Level 14.2: Simplifies binomial expressions.

Number of Periods: 02

Introduction:

- The value of simple algebraic expressions can be found by substituting a value for the algebraic terms in them. The algebraic expressions presented in this grade are devoid of roots but contain fractions. The values are found by substituting directed numbers. They also include algebraic expressions with parentheses of the following form.
  $a(x \pm y) + b(x \pm y)$
- In this section, it is also expected to simplify two simple algebraic expressions of the type $(x \pm a)(x \pm b); a, b \in \mathbb{Z}$ .The product of two binomial expressions such as these can also be obtained through area also.

Learning outcomes relevant to Competency Level 14.1:

1. Finds the value of an algebraic expression which does not involve powers or roots by substituting directed numbers.

Glossary of terms:

Algebraic expression	- වීජීය ප්‍රකාශනය	- அட்சரகணிதக் கோவைகள்
Algebraic term	- වීජීය පදය	- அட்சரகணித உறுப்பு

Instructions to plan the lesson:

Given below is a specimen lesson adopting an activity in pairs for developing in students the subject concepts relating to competency level 14.1.

Time: 40 minutes

Quality inputs:

- Copies of the work sheet

Instructions for the teacher:

Approach:

- Recall how the knowledge of simplifying integers is used when finding the value of an algebraic expression by substituting the given value of an algebraic term.
- Draw students' attention to the use of BODMAS rule when simplifying algebraic expressions.
- Reinforce students' knowledge of multiplying a whole number by a fraction.

Development of the lesson:

- Distributes work sheets, one for two students.
- Guide the students to copy the work sheet and fill in the blanks,
- Move among the students, help them when required and assess them while the students are involved in the activity.
- After completion of the activity, build up the whole of the lesson taking students' findings into consideration and recalling how algebraic expressions are simplified by substituting a given value to an algebraic term.5

Activity sheet for the Students :

- Observe the work sheet well and complete it while discussing.
- Find the value of each algebraic expression according to the values of x given.

Algebraic expression	Values of x		
	+2	- 2	$\frac{1}{2}$
(i) $2x + 3$	....	....	$2\times\frac{1}{2}+3$ $1+3$ 4
(ii) $2x-3$	.....	.....	.....
(iii) $2(2x - 3)$	.....	$2\{2\times(-2)-3\}$ $2(-4-3)$ $2x-7=-14$	.....
(iv) $\frac{1}{2}(2x+3)$	$\frac{1}{2}(2\times2+3)$ $\frac{1}{2}(4+3)$ $\frac{1}{2}\times7$ $\frac{7}{2}$	.....	.....

Assessment and evaluation:

- Assessment criteria:
  - Substitutes a given value in an algebraic expression correctly.
  - Simplifies integers correctly.
  - Simplifies fractions correctly.
  - Works cooperatively and completes the relevant activity sheet correctly.
- Direct the students to do the relevant exercises in lesson 6 of the textbook.

For your attention...
Development of the lesson:

- Plan lesson as appropriate for the learning outcomes relating to the competency level 14.2 and implement.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 6 of the text book.

For further reference:

- http://www.youtube.com/watch?v=fGThIRpWEE4

7. Factors of algebraic Expressions

Competency 15 : Factorizes algebraic expressions by systematically exploring various methods.

Competency Level 15.1: Presents algebraic expressions in a simple form by factorizing.

Competency Level 15.2: Factorizes quadratic expressions to fulfill mathematical requirements.

Number of Periods: 02

Introduction:

In grade 8, students have learnt how the common factor of an algebraic expression consisting of up to three terms can be isolated. In this section, it is expected to separate common factors in an algebraic expression of four terms taking two terms each time. This ability of factorisation is essential for the separation of factors of trinomial quadratic equations in the future. Therefore, factorisation of algebraic expressions is very importance for the students. This can also be used to find the length and breadth of rectangles of given area in which the length and breadth are given as algebraic terms or expressions.

Learning outcomes relevant to Competency Level 15.1:

1. Factorizes an algebraic expression with up to four terms by taking two terms at a time.
2. Factorizes an algebraic expression with four terms, where the factors are binomial expressions.

Glossary of terms:

Factors	-	සාධක	-	காரணிகள்
Commom factor	-	පොදු සාධක	-	பொதுக்காரணிகள

Instructions to plan the lesson:

Given below is a specimen lesson adopting lecture-discussion method coupled with an individual activity for developing in students the concept of factorising four terms algebraic expressions in which the common factor is binomial relevant to the learning outcome 1 under the competency level 15.1.

Time: 40 minutes

Instructions for the teacher:

Approach:

- Recall how the common factor of an algebraic expression comprising two algebraic terms with a common factors is isolated.
- Extends this up to expressions with three algebraic terms while discussing.
- Also recall how the area of rectangles in which the length and breadth are given in algebraic terms is found.

Development of the lesson:

- Present the figure with rectangles in the annex I to the students. Obtain as $ax + ay$ an algebraic expression for the area of the rectangle CDEF represented as part 1.
- Separate the common factor of that algebraic expression $ax + ay$ and indicate it as a product of two factors $(x+y)$
- Obtain from students that the length of the rectangle so is $(x+y)$ and its breadth is a.
- Similarly, by separating the area of the rectangle FEGH into two factors elicit from students that its length is $(x+y)$ and the breadth is b.
- Show that the length and breadth of the rectangle CDGH are $(x+y)$ and $(a+b)$ respectively and its area is $(a+b)(x+y)$.
- Through a discussion with students, obtain the fact that the sum of the areas of the rectangles CDEF and FEGH is $ax+ay+bx+by$.
- Obtained from students that the sum of the four parts of the rectangle $ax+ay+bx+by$ is equal to $(a+b)(x+y)$

  i.e. $ax+ay+bx+by = (a+b)(x+y)$
- Factorise an expression such as $ax+ay+bx+by$ without equating the areas.
- After reinforcing the subject concept in students by solving several problems, direct them to factorise other types of algebraic expressions such as $x^2+ax+bx+ab$

Assessment and evaluation:

- Assessment criteria:
  - Writes the area of a rectangle separated in to parts as the sum of the areas of those parts.
  - Separates the common factors of an algebraic expression with two terms.
  - Accepts that by factorising an algebraic expression given in the form of the area of the rectangle, its length and breadth can be obtained.

- Factorises an algebraic expression with four terms by writing the area of a rectangle in two different ways.
- Participates actively to the activity giving correct answers.

- Direct the students to do the relevant exercises in lesson 7 of the textbook.

For your attention...
Development of the lesson:

- After factorising four term algebraic expressions such as $x^2+ax+bx+ab$, guide the students to factorise expressions with other signs.
- Discuss how the signs should be manipulated when factorising expressions with terms such as $k^2-k+1-k$.
- Establish the concepts through extra exercises.
- Plan and implement a suitable activity to achieve the subject concepts relevant to the learning outcome 2 of the competency level 15.1.

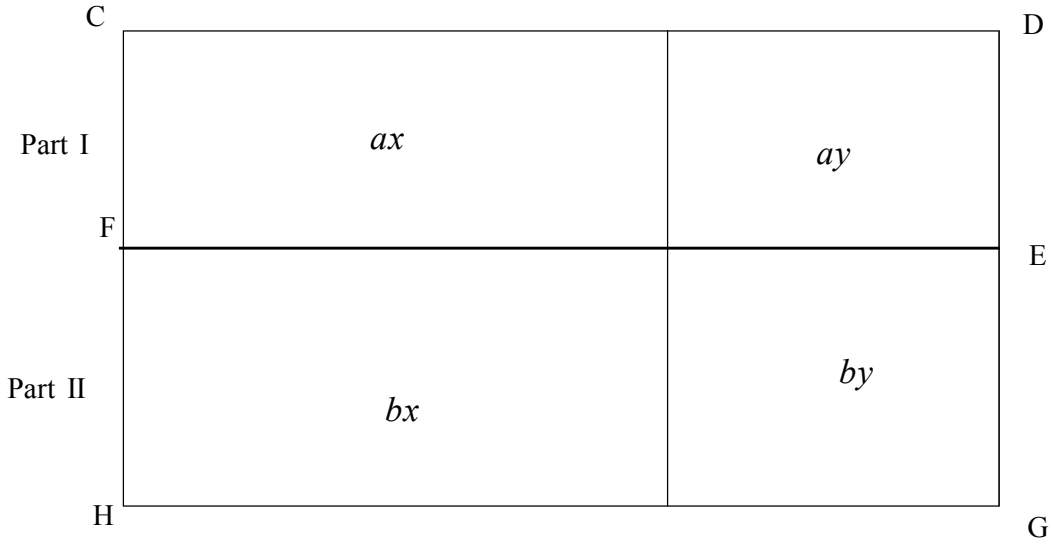
Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 7 of the text book.

For further reference:

- http://www.youtube.com/watch?v=HXIj16mjfgk
- http://www.youtube.com/watch?v=nOZTe8jU2g4
- http://www.youtube.com/watch?v=fVIZmOQBS5M
- http://www.youtube.com/watch?v=jmbg-DKWuc4
- http://www.youtube.com/watch?v=YahJQvY396o
- http://www.youtube.com/watch?v=tvnOWIoeeaU

Annex - 1



8. Angles Related to Straight Lines and Parallel Lines

Competency 21 : Makes decisions by investigating the relationships between various angles.

Competency Level 21.1: Establishes the relationships between the angles related to straight lines.

Competency Level 21.2: Investigates the angles formed by various intersecting straight lines.

Competency Level 21.3: Identifies the relationships between the angles related to parallel lines.

Number of Periods: 07

Introduction:

The boundary that separates a surface into two parts is a line. When two points are given, the interval that connects them is a straight line. A straight line indefinitely spreads to either side. Therefore, in mathematical works we draw segments of straight lines but not straight lines.
The theorems given in the work 'The Elements' written by the mathematician Euclid in the third century B.C. are built up on plane figures. This lesson introduces three theorems presented in that book with regard to straights lines. As the theorems frequently used in geometric deduction, these are very important.

Learning outcomes relevant to Competency Level 21.3:

1. Identifies the theorem, "When a transversal intersects a pair of straight lines, if a pair of alternate angles is equal, or a pair of corresponding angles is equal or the sum of a pair of allied angles equals two right angles, then the pair of straight lines is parallel"

2. Verifies the theorem, "When a transversal intersects a pair of straight lines, if a pair of alternate angles is equal, or a pair of corresponding angles is equal or the sum of a pair of allied angles equals two right angles, then the pair of straight lines is parallel"

3. Solves problems by applying the theorem, "When a transversal intersects a pair of straight lines, if a pair of alternate angles is equal, or a pair of corresponding angles is equal or the sum of a pair of allied angles equals two right angles, then the pair of straight lines is parallel"

4. Identifies the following converse of the above theorem, "When a transversal intersects a pair of parallel straight lines,
   - pairs of alternate angles formed are equal
   - pairs of corresponding angles formed are equal
   - the sum of each pair of allied angles formed equals two right angles.

5. Verifies the following converse of the above theorem, "When a transversal i ntersects a pair of parallel straight lines,
   - pairs of alternate angles formed are equal
   - pairs of corresponding angles formed are equal
   - the sum of each pair of allied angles formed equals two right angles.

6. Solves problems by applying the following converse of the above theorem, "When a transversal intersects a pair of parallel straight lines,
   - pairs of alternate angles formed are equal
   - pairs of corresponding angles formed are equal
   - the sum of each pair of allied angles formed equals two right angles

Glossary of terms:

Parallel line	- සමාන්තර රේඛාව	- சமாந்தரக் கோடுகள்
Transversal line	- තීර්යක් රේඛාව	- குறுக்கோடி
Vertically opposite angles	- ප්‍රතිමුඛ කෝණ	- குத்தெதிர்க்கோணங்கள்
Corresponding angles	- අනුරූප කෝණ	- ஒத்தகோணங்கள்
Alternate angles	- ඒකාන්තර කෝණ	- ஒன்றுவிட்டகோணங்கள்
Allied angles	- මිත්‍ර කෝණ	- நேயக்கோணங்கள்
Theorem	- ප්‍රමේයය	- தேற்றம்
Converse	- විලෝමය	- மறுதலை

Instructions to plan the lesson:

A specimen lesson designed with adoption of a student activity is given below to introduce the theorem relating to learning outcome 1 and verify that theorem relating to outcome 2 under competency level 21.3 after establishing in students the learning outcomes relevant to competency level 21.1 and 21.2.

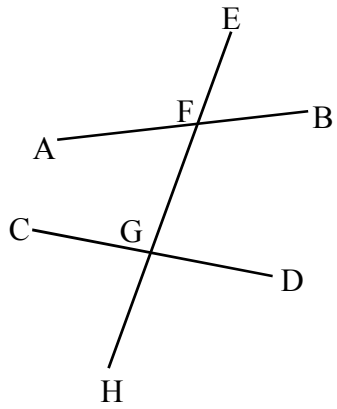
Time: 80 minutes

Quality inputs:

- 10 cm × 10 cm oil papers, three for each group
- Copies of the activity sheet, three for each group
- Poster given in annex 1

Instructions for the teacher:

Approach:



- Display the diagram on the board and discuss with students about the straight lines and angles in it.
- During the discussion recall students about the transversal, the paired angles corresponding, alternate and allied, the approximate relationship of the positions of corresponding and alternate angles to letters Z and F and the situation of the pair of allied angles.
- Recall that the parallelism of two straight lines can be examined with the ruler and the set square with a right angle and how it is examined. Direct the students to investigate the geometric relationship between these angles and lines.

Development of the lesson:

- Display the poster with the theorem in annex 1. Show that the straight lines forming the angles are parallel when alternate angles are equal or corresponding angles are equal or the sum of the allied angles is equal to 180^0 and introduce the theorem.
- Divide students into groups of four to get them ready for the activity designed to verify the theorem.
- To each group distributea copy of the activity sheet, three pieces of oil papers.
- While the students are engaged in the activity, help the students who need assistance.
- At the end of the activity , discuss about the students' findings and confirm that the theorem is true.

Activity sheet for the students:

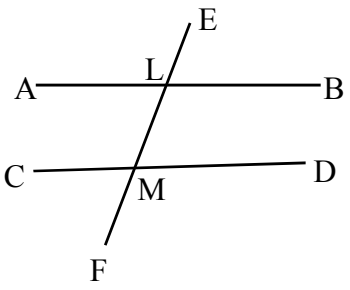


figure ①

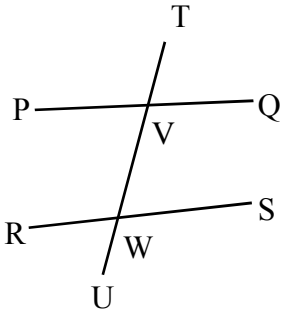


figure ②

- Copy the two diagrams given to you separately on oil papers. Labels the diagrams with the letters similar to those in the diagram.

- Mark in both copies the angle at vertex L corresponding angle to $F\hat{M}D$ in figure ①. Using the oil paper see whether the angles $F\hat{M}D$ and $E\hat{L}B$ in the activity sheet are equal. Accordingly note the relationship between corresponding angles in figure ①.
- Measure those two angles with the protractor and confirm the above decision made.
- Repeat the same activity with figure ②, find the corresponding angle to $R\hat{W}U$ and see whether those two angles have same relationship mentioned above.
- Mark in both copies the angle at vertex M alternate angle to $A\hat{L}M$ in figure ①. Using the oil paper see whether the angles $A\hat{L}M$ and $L\hat{M}D$ in the activity sheet are equal. Accordingly note the relationship between alternate angles in figure ①
- Measure those two angles with the protractor and confirm the above decision made.
- Repeat the same activity with figure ②, find the alternate angle to $Q\hat{V}W$ and see whether those angles have same relationship mentioned above.
- Identify the allied angle to $B\hat{L}M$ at vertex M, measure those two angles with the protractor and obtain the sum of those two angles. Accordingly note the relationship between allied angles in figure ①.
- Identify the allied angle to $P\hat{V}W$ at vertex W, measure those two angles with the protractor and obtain the sum of those two angles. See whether those angles have same relationship mentioned above.
- Using the right angle corner made with a paper, examine whether CD and AB are parallel. Confirm same using the set square and the ruler.
- Using the paper corner ,examine whether the lines PQ and RS are parallel and confirm same using the set square and the ruler.
- Get ready to present how the theorem can be verified using your results.

Assessment and evaluation:

- Assessment criteria:
  - States that the theorem related to parallel lines correctly.
  - Verifies that when the corresponding angles and alternate angles are equal of the angles formed when two straight lines are intersected by a transversal, the straight lines are parallel.
  - Accepts that the lines are parallel when the sum of two allied angles is equal to two right angles.
  - Examines the parallelism of two lines using a right angle corner.
  - Uses verification to interpret specific occasions.
- Direct the students to do the relevant exercises in lesson 8 of the textbook.

For your attention.....
Development of the lesson:

- Plan and implement a suitable lesson to deveop in students the abilities relevant to the learning outcome 3,4,5 and 6 under competency level 23.1.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 8 of the text book.

For further reference:

- http://www.youtube.com/watch?v=wRBMmiNHQaE
- http://www.youtube.com/watch?v=2CZrkdtgeNU
- http://www.youtube.com/watch?v=gRKZaojKeP0
- http://www.youtube.com/watch?v=H-E5rlpCVu4
- http://www.youtube.com/watch?v=2WjGD3LZEWo
- http://www.youtube.com/watch?v=Ld7Vxb5XV6A
- https://www.youtube.com/watch?v=aq_XL6FrmGs

Annex 1

Poster

When two straight lines are intercepted by a transversal, those straight lines are parallel if

- the corresponding angles are equal or
- the alternate angles are equal or
- the sum of a pair of allied angles is equal to two right angles.

9. Liquid Measurements

Competency 11 : Works critically with the knowledge on liquid measures to fulfill daily needs.

Competency Level 11.1: Develops relationships between units of liquid measurements.

Number of Periods: 03

Introduction:

The volume of a certain quantity of a liquid can be measured by the units by which the capacity of a container of that liquid is measured. The capacity of a container is the volume of the liquid which completely fills that container. The volume of an object is the space occupied by that object whereas the volume of a liquid is the extent of space occupied by that liquid. Therefore there should be a relationship between the units of measuring capacity and volume. Capacity is measured by unit such as *ml* and *l* whereas volume is measured by such as mm^3, cm^3 and m^3. Since the conversion from one unit of measurement to another is essential in day to day life , it is essential to understand the relationship among these units. Thus the aim of this section is the understanding of the relationship among these units of measurement, conversion of the units of liquid measurement using those relationships and solving problems related to them.

Learning outcomes relevant to Competency Level 11.1:

1. Identifies the relationship between ml and cm^3.
2. Develops the relationship l between and cm^3.
3. Develops the relationship between l and m^3.
4. Converts liquid measurements in one unit to another, by using the relationships between *ml* and cm^3, between l and cm^3, and between *l* and m^3.
5. Solves problems related to the conversion of units of liquid measurements.

Glossary of terms:

Volume	- පරිමාව	- குறைநிலுவை
Capacity	- ධාරිතාව	- கூட்டு வட்டி-
Cube	- ඝනකය	- மாத அலகுகளின் எண்ணிக்கை
Cuboid	- ඝනකාභය	- தவணை -

Instructions to plan the lesson:

This lesson expects to develop in students the subject concepts relevant to the learning outcome 1 under the competency level 11.1.

Time: 40 minutes

Quality inputs:

- The following objects made with a transparency so that water doesn't leak
  - a 2 cm × 2 cm × 2cm cube
  - a 2 cm × 2 cm × 3cm cuboid
  - a 2 cm × 3 cm × 3cm cuboid
  - a 2 cm × 3 cm × 4cm cuboid
  - a 2 cm × 3 cm × 5cm cuboid
- Several syringes
- Vessels of water
- Rulers
- Copies of work sheets

Instructions for the teacher:

Approach:

- Show several vessels and bottles, ask about their capacity and volume and lead a discussion.
- Explain that capacity of a container is the volume of a liquid required to fill that container completely, the volume of an object is the space it occupies and liquid volume is the space occupied by that liquid.
- Discuss that units of measuring capacity are *ml* and *l* which the units of measuring volume are mm^3, cm^3 and m^3.
- Recalling the need of the relationship among these unit types when solving problems in everyday life, approach the lesson by inquiring into the relationship among them.

Development of the lesson:

- Divide the students into group as appropriate and distribute to each group a copy of the work sheet, a cuboid, a vessel of water, a syringe and a ruler.
- Engage the students in the relevant activity.
- Give an opportunity to present students' findings.
- Based on the students' findings, obtain the relationship between cm^3 and *ml* is $1cm^3 = 1ml$

Activity sheet for the Students :

- Using the ruler, measure to the nearest centemtre the length, breadth and height of the cuboid provided to you.
- Thereby, calculate the volume of the cuboid.
- Draw water in to the syringe given and fill the cuboid completely with water.
- Express in *ml* the volume of water required to fill the cuboid completely.
- Comparing those two volumes, obtain a relationship between cm^3 and *ml*.
- Present the relationship you obtained to the class.

Assessment and evaluation:

- Assessment criteria:
  - State that the capacity of a container is the volume of a liquid filling it completely and the volume of an object is the total amount of space it occupies.
  - Calculates the volume of a cuboid by measuring its length, breadth and height.
  - By comparing, states that $1 cm^3 = 1 ml$.
  - Facilitates day to day affairs by comparing the units of measuring capacity and volume.
  - Acts in the group respecting the ideas of the others.
- Direct the students to do the relevant exercises in lesson 9 of the textbook.

For your attention...
Development of the lesson:

- Plan and implement lessons as appropriate to achieve the other learning outcomes under competency level 11.1

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 9 of the text book.

For further reference:

-
-

10. Direct Proportionality

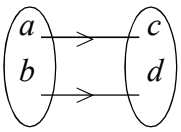
Competency 4 : Uses ratios to facilitate day to day activities.

Competency Level 4.1: Engages in calculations by considering direct proportions.

Number of Periods: 06

Introduction:

- A ratio is a relationship between two similar quantities whereas a proportion is a numerical relationship between two dissimilar quantities.
- When there is definite numerical relationship among the corresponding elements in two quantities belonging to the proportional relation, the quantities are said to have a proportion.
- On the property that the ratio between any two elements in the first quantity is equal to the ratio between the two corresponding elements in the other quantity and when the value of the first quantity increases, the corresponding value of the other quantity too increases, the two quantities are said to have a direct proportion.



$a:b=c:d$

- When the first quantity is x and the second quantity is y, the fact that x is directly proportional to y is indicated as $x \alpha y$.

  Then $x = ky$

  $\therefore \frac{x}{y} = k$

- The problems on directly proportional quantities can also be solved using properties of proportionality , by unitary method and also algebraically.
- The aim of this lesson is to introduce proportionality and direct proportionality and give guidance to solve numerical problems related to them.

Learning outcomes relevant to Competency Level 4.1:

1. Identifies proportion.
2. Explains direct proportions using examples.
3. Writes the relationship between two quantities which are directly proportional in the form $y = kx$.
4. Solves problems related to direct proportions by applying the unitary method.

5. Solves problems related to direct proportions by using the definition of proportion.
6. Solves problems involving the conversion of foreign currency by applying the knowledge on direct proportions.
7. Solves problems on direct proportions by expressing the relationship algebraically

Glossary of terms:

Proportion	- සමානුපාතය	- பங்குகள்
Direct Proportion	- අනුලෝම සමානුපාතය	- மூலதனம்
Quantities	- රාශි	- பங்கொன்றின் பிரதிப்பயன
Foreign Currencies	- විදේශ මුදල්	- வரையறுக்கப்பட்ட கம்பனி
Algebraic form	- වීජීය ආකාරය	- காணப்பட்ட மூலதனம்

Instructions to plan the lesson:

Given below is a specimen lesson designed to develop in students the concepts of proportionality relevant to the learning outcomes 1 and 2 under the competency level 4.1 adopting lecture-discussion method with an individual activity.

Time: 40 minutes

Instructions for the teacher:

Approach:

- Display the following clauses on the board.
  - The ages of A and B respectively are 10 years and 15 years.
  - A wheel rotates 40 rounds in 2 minutes.
- Asking students' ideas about the above two statements, let student present in the simplest form the ratio of ages of A and B
- Recall that the statement **the wheel rotates 20 rounds in 2 minutes** indicates a proportion.
- Involve students in the following activity to identify the characteristics of a proportionality.

Development of the lesson:

- Display the following table on the board and let students complete it individually.

The price of a pen is Rs. 12.

First quantity(Numbers of pens)	Second quantity (Cost Rs.)
1	12
2	.....
3	.....
4	.....
5	.....
6	.....
7	.....
8	.....
9	.....
10	.....

- Show that the first column of the table gives the number of pens and the second column gives the cost.
- Assign students to write in the simplest form the numerical relationship existing between an element in the first quantity and the corresponding element in the second quantity as a ratio as follows.

  1 : 12 = ...
  2 : 24 = ...
  3 : 36 = ...
  4 : 48 = ...
- Surface that, as per the ratio above , there is a constant ratio between the elements of the two quantities and say that such a relationship is called a **proportion**.
- Instruct to write in the above table itself in the simplest form the ratio between any two elements in the first quantity and the ratio between the corresponding elements in the second quantity as follows.

Ratio between two elements in the first quantity	The ratio between the two corresponding elements in the second quantity and its simplest form
1 : 3	12:36 = 1:3
..... :	..... : .... = ... : ....
..... :	..... : .... = ... : ....
..... :	..... : .... = ... : ....
..... :	..... : .... = ... : ....

- On the basis of the answers and also in the light of the following clause, discuss the relationship between those two ratios.

The ratio between any two elements in the first quantity is equal to the ratio between the two corresponding elements in the second quantity.

- Discussing about the increase in the value of the corresponding element with the increase in value of an element in the first quantity and the number of pens and their cost, introduce direct proportionality.
- In the light of the characteristics shown above, show that there is a direct proportionality between the books the same size and their mass.
- Directing students to select direct proportionalities from the following proportionalities, recall again about what is meant by 'directly proportional'
    - Equal size eggs and their price
    - The length of a side of a square and its perimeter.
    - The length of a side of a square and its area.
    - The distance travelled by a vehicle running with a constant speed and the time spent.

Assessment and evaluation:

- Assessment criteria:
    - Of two quantities different from each other, identifies as a proportionality the relationships where the ratio between an element in the first quantity and the corresponding element in the second quantity is constant.
    - Describes as a direct proportion a relationship in which the value of the second quantity increases with the increase in the value of the first quantity.
    - Presen89 ts the characteristics of a direct proportion.
    - Selects direct proportionalities from given relationships.
    - Participates actively in the discussion and gains learning experiences.
- Direct the students to do the relevant exercises in lesson 10 of the textbook.

For your attention...

Development of the lesson:

- Give guidance to write in algebraic form the relationship between two quantities which are directly proportional.
- Plan and implement suitable learning teaching method to achieve the learning outcomes 3, 4, 5, 6, and 7 under the competency level 4.1.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 10 of the text book.

For further reference:

- http://www.youtube.com/watch?v=4ywTWCaLmXE
- https://www.youtube.com/watch?v=d7rAlcNHDUI
- https://www.youtube.com/watch?v=Zm0KaIw-35k
- http://www.youtube.com/watch?v=KiVGac1aBt8

11. Calculator

Competency 6 : Uses logarithms and calculators to easily solve problems in day to day life.

Competency Level 6.2: Uses the calculator to facilitate calculations.

Number of Periods: 02

Introduction:

The ancient human has restored to pebble keeping and drawing lines on a tablet of clay for counting. In that, no calculation has be made .Afterwards, it seems that man has used the set of fingers as a calculator. In about 100 B.C., Egyptians and the Chinese had used the abacus.

Abacus is also type of a calculator. Napierian logarithms too is a sort of calculators. Blaise Pascal produced the mechanical calculator and in 1833 Charles Babage invented the analysis machine. As the modern computer is designed on his principles, Charles Babage is known as the father of computer science.

Given above is a diagram of a scientific calculator. In any calculator there four keys for the four mathematical operations [+], [-] ,[×], [÷].Key [On] starts the action of the calculator while [Off] deactivate it. The key [=] gives the result of the mathematical operation. Under the competency level 6.2, it is expected that the students will identify and use the keys [+], [-] ,[×], [÷], [=], [%], [x^2] and [$\sqrt{x}$] in the scientific calculator.

Learning outcomes relevant to Competency Level 6.2:

1. Identifies the keys [On], [Off], [+], [-] ,[×], [÷] and [=] in the scientific calculator
2. Uses the scientific calculator using the keys [On], [Off], [+], [-] ,[×], [÷] and [=]
3. Identifies the keys [%], [x^2] and [$\sqrt{x}$] in the scientific calculator.
4. Uses the keys [%]" [x^2] and [$\sqrt{x}$] in the scientific calculator.
5. Accepts that efficiency can be increased by using the scientific calculator.
6. Check the accuracy of the answers by using the scientific calculator.

Glossary of terms:

Scientific calculator	- විද්‍යාත්මක ගණකය	- விஞ்ஞானமுறைக் கணிகருவி
Key	- යතුර	- சாவி
Key board	- යතුරු පුවරුව	- சாவிப்பலகை
Multiplication	- ගුණ කිරීම	- பெருக்கல்

Instructions to plan the lesson:

The aim of this is to build up in students the subject concepts related to learning outcomes 1 and 2 under the competency level 6.2. The sequel gives a specimen lesson that adopts guided inquiry method to achieve this aim.

Time: 40 minutes

Quality inputs:

- Scientific calculator (one for each group)
- Copies of the activity sheets
- A felt pen and an A4 sheet

Instructions for the teacher:

Approach:

- Direct the students to get the answer for the problem $\frac{8.625}{3.75}$.
- Ask about the answer that can be obtained.
- Say that it is easy to solve this using a calculator and display a scientific calculator and approach the lesson by asking about its keys.

Development of the lesson:

- Make the students aware about the keys of a scientific calculator and their functions.

Key	Function
On	Putting on the calculator
Off	Putting off the calculator
+	Adding two numbers
-	Subtracting two numbers
×	Multiplying two numbers
÷	Dividing one number by another
=	Obtaining the answer

- After introducing the keys in the calculator, show that the problem presented on the board can easily be solved by using the calculator.

- Show that the relevant process can be indicated as

  $\boxed{On} \rightarrow 8.625 \rightarrow \boxed{\div} \rightarrow 3.75 \rightarrow \boxed{=} \rightarrow 2.3$
- Group the students as appropriate and give each group a copy of the activity sheet.and assign the work for each group.
- Distribute the necessary equipment and materials to the groups and engage in the activity.
- At the end of the activity conduct a discussion. During the discussion explain that the calculator should be switched on by the key and in simplifications under basic mathematical operations first the number and then the relevant mathematical operation should be entered. Thereafter, the second number should be entered and relevant key should be used to obtain the answer.

Activity sheet for the students:

- Study the activity sheet you have got well.

A	B	C	D
25 + 31	45 + 11	52 + 63	74 + 29
73 - 20	54 - 12	48 - 23	57 - 41
82 × 3	58 × 2	73 × 8	64 × 7
175 ÷ 5	536 ÷ 4	528 ÷ 4	508 ÷ 2

- Select the part assigned to your group.
- Obtain the value of the mathematical expressions given using the scientific calculator.
- Using a flow diagram show how you obtained that value.
- Present the answer you got to the whole class.

Assessment and evaluation:

- Assessment criteria:
  - Identifies correctly the calculator key relevant to the calculation.
  - Simplifies a mathematical expression correctly using the calculator.
  - Shows by a correct arrow diagram how the answer was obtained by solving the mathematical expression.
  - Accepts that it is easier to use the scientific calculator to simplify mathematical expression with mathematical operations.
  - Learns through experience.
- Direct the students to do the relevant exercises in lesson 11 of the textbook.

For your attention.....

Development of the lesson:

- Plan and implement suitable activities to develop in students the subject concepts relevant to learning outcomes 3, 4, 5 and 6.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 11 of the text book.

For further referenc:

- http://www.youtube.com/watch?v=cK1egPBjJXE
- http://www.youtube.com/watch?v=OPxzx75bAfk
- http://www.youtube.com/watch?v=DaoJmvqU3FI
- http://www.youtube.com/watch?v=pf41fDSWeoA
- http://www.youtube.com/watch?v=3jBfLaLrk6I
- http://www.youtube.com/watch?v=_qzs1zozTBo
- http://www.youtube.com/watch?v=fh8gkPW_6g4
- http://www.youtube.com/watch?v=BkwI6Uu0vi4
- http://www.youtube.com/watch?v=_MIn3zFkEcc

12. Indices

Competency 6 : Uses logarithms and calculators to easily solve problems in day to day life

Competency Level 6.1: Simplifies powers by applying the laws of indices.

Number of Periods: 03

Introduction:

Logarithms are based on the concept of indices. In previous grades the students have learnt identification of powers, index notation, identification of powers whose base is an algebraic symbol, expansion of powers, finding values by substituting positive integers for the algebraic terms in powers with algebraic terms and expansion of powers in a product.
This section aims to develop in students the ability to recognize the application of indices rules and use them for simplification of expression with indices in multiplication and division of powers with equal bases and in finding the power of a power. Hence under this section the subject matter $a^m \times a^n = a^{m+n}$, $\frac{a^m}{a^n} = a^{m-n}$, $\left(a^m\right)^n = a^{mn}$, $a^0 = 1$ and $a^{-n} = \frac{1}{a^n}$ are discussed.

Learning outcomes relevant to Competency Level 6.1:

1. Identifies the laws of indices that are applied when multiplying powers and dividing powers.
2. Identifies the laws of indices that are applied when finding the power of a power.
3. Recognizes that $a^0 = 1$ and $a^{-n} = \frac{1}{a^n}$
4. Applies the laws of indices to simplify expressions involving indices.

Glossary of terms:

Index	-	දර්ශකය	-	சுட்டிகள்
Rules for indices	-	බලය	-	சுட்டி விதிகள்
Power	-	දර්ශක නීති	-	வலு
Division	-	බෙදීම	-	வகுத்தல்
Multiplication	-	ගුණ කිරීම	-	பெருக்கல்

Instructions to plan the lesson:

Given below is a specimen lesson plan that adopts a group activity for developing in students the subject concepts related to the first learning outcome 1 under the competency level 6.1.

Time: 40 minutes

Quality inputs:

- Copies of the activity sheets
- A felt pen and an A4 sheet (for each group)

Instructions for the teacher:

Approach:

- Ask what is a power and write a power such as 2^5 on the board.
- Have access to the lesson by involving students to expand that power.
- Surface the need of multiplying two or more powers and dividing two or more powers.

Development of the lesson:

- Group the students as appropriate.
- Distribute a copy of the activity sheet and an A_4 sheet to every group and let them do the activity according to the instructions given.
- After completion of the group activity, elicit ideas from the groups and make a review.
- Surface index rules used when multiplying or dividing two or more powers and give a summery as follows.
  - $a^m \times a^n = a^{m+n}$
  - $\frac{a^m}{a^n} = a^{m-n}$

Activity sheet for the students:

- Observe the activity sheet well, discuss it within the group and fill in the blanks as appropriate.(In first, fill in the blanks in first column.)

Fill in the blanks	Fill in the blanks and obtain the final answer obtained on the left hand side by another method
$2^2 \times 2^3$ $= (\ldots\ldots \times \ldots\ldots) \times (\ldots\ldots \times \ldots\ldots \times \ldots\ldots)$ $= \ldots\ldots \times \ldots\ldots \times \ldots\ldots \times \ldots\ldots \times \ldots\ldots$ $= 2^{\ldots\ldots}$	$2^2 \times 2^3$ $= 2^{\ldots\ldots + \ldots\ldots}$ $= 2^{\ldots\ldots}$
$a^3 \times a$ $= (\ldots\ldots \times \ldots\ldots \times \ldots\ldots)$ $= a^{\ldots\ldots}$	$a^3 \times a$ $= a^{\ldots\ldots + \ldots\ldots}$ $= a^{\ldots\ldots}$

$\frac{3^5}{3^2}$ $= \frac{\ldots\ldots\times\ldots\ldots\times\ldots\ldots\times\ldots\ldots}{\ldots\ldots\times\ldots\ldots}$ $= \ldots\ldots\times\ldots\ldots\times\ldots\ldots$ $= 3^{\ldots\ldots}$	$\frac{3^5}{3^2}$ $= 3^{(\ldots\ldots)-(\ldots\ldots)}$ $= 3^{\ldots\ldots}$
$\frac{x^4}{x^2}$ $= \frac{\ldots\ldots\times\ldots\ldots\times\ldots\ldots\times\ldots\ldots}{\ldots\ldots\times\ldots\ldots}$ $= \ldots\ldots\times\ldots\ldots\times\ldots\ldots$ $= x^{\ldots\ldots}$	$\frac{x^4}{x^2}$ $= x^{(\ldots\ldots)-(\ldots\ldots)}$ $= x^{\ldots\ldots}$

- Using the above findings simplify the following.

  (*a*) $y^4 \times y^2$ (*b*) $\frac{b^3}{b^2}$

Assessment and evaluation:

- Assessment criteria:
  - Identifies the index rule used in the multiplication of powers.
  - Identifies the index rule used in the division of powers.
  - Multiplies and divides powers using index rules.
  - Accepts that index rules facilitate multiplication and division of powers.
- Direct the students to do the relevant exercises in lesson 12 of the textbook.

For your attention...

Development of the lesson:

- Plan lesson as appropriate and implement to develop the learning outcomes 2, 3 and 4 under competency level 6.1.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 12 of the text book.

For further reference:

- http://www.youtube.com/watch?v=-TpiL4J_yUA
- http://www.youtube.com/watch?v=tvj42WdKlH4
- http://www.youtube.com/watch?v=U8kmaUXaPJY
- http://www.youtube.com/watch?v=jYOfMszfzAQ
- http://www.youtube.com/watch?v=Of8ezQj1hRk

13. Loci and Constructions

Competency 27 : Analyzes according to geometric laws, the nature of the locations in the surroundings.

Competency Level 27.1: Uses the knowledge on the basic loci to determine the location of a point.

Competency Level 27.2: Uses geometric constructions in various activities.

Number of Periods: 09

Introduction:

In this section it is expected to discuss identification of the four basic loci, construction of a bisector to a line, construction of a bisector of an angle, copying an angle equal to a given angle and constructions of angles of given values relevant to competency level 27.1 and 27.2.

In the dynamic world, we frequently see objects moving. These move mostly under external influences. Based on the external forces or factors affecting the motion of an object, a prediction can be made about the path of that object. The path of a point moving under the influence of an external force is called a locus. It is the dynamic concept of a locus. As regards the static concept, the combination of all the locations of a point too gives rise to a locus.

This section includes facts about basic loci and selected geometrical constructions. Further, this section encompasses facts relating to the correct usage of geometrical instruments in geometrical constructions and how the constructions made are validated.

There are four basic types of loci.

1. The locus formed by the union of all the points on a plane equidistant from a fixed point or the locus of a point moving at a constant distance from fixed a point is a circle.
2. All the points located on a plane equidistant from two fixed points or the locus of a point moving at an equal distance from two fixed points is the perpendicular bisector of the line joining those two points.
3. The locus formed by the union of the all the points located at an equal distance from a fixed line or the locus of a point moving at a constant distance from a fixed line are two straight lines parallel to the fixed line with a constant gap.

4. The locus formed by the union of all the points on a plane equidistant from two non parallel lines or the locus of a point moving at an equal distance from two non parallel lines is the bisector of the angle formed at the meeting point of those two lines.

By discussing with students phenomena seen in the natural environment such as the path of a tip of a clock arm, the path taken by finger tips when opening a tap and the path of a rain drop falling from the edge of a roof a practical knowledge regarding loci can be given.

Learning outcomes relevant to Competency Level 27.2:

1. Constructs the bisector of an angle.
2. Constructs angles of magnitude 60^o, 30^o, 120^o.
3. Constructs angles of magnitude 90^o, 45^0.
4. Constructs other angles that can be constructed using the construction of angles of magnitude 60^o, 90^o, 30^o, 45^o, 120^o.
5. Copies an angle equal to a given angle.
6. Studies methods of validating the accuracy of the constructions

Glossary of terms:

Locus	- පථය	- ஒழுக்கு
Circle	- වෘත්තය	- அவட்டம்
Fixed point	- අචල ලක්ෂ්‍යය-	- நிலையான புள்ளி
Constant distance	- නියත දුර	-மாறாத் தூரம்சம
Equal distance	- සමාන දුර	- சம தூரம்
Bisector	- සමච්ඡේදකය	- இருகூறாக்கி
Perpendicular	- ලම්බය	- செங்குத்து
Perpendicular bisector	- ලම්බ සමච්ඡේදකය	- இருசமவெட்டிச் செங்குத்து
Parallel lines	- සමාන්තර රේඛා	– சமாந்தரக்கோடுகள்
Construction	- නිර්මාණය	- அமைப்பு
Intersection	- ඡේදනය	- இடைவெட்டுதல்
Straight line	- සරල රේඛාව	- நேர்கோடு

A specimen lesson designed as a stepwise, individual student activity coupled with a teacher demonstration for developing in students the subject concepts related to the learning outcomes 1 and 2 under the competency level 27.2 after achieving the subject concepts relevant to the learning outcomes under the competency level 27.1 is given below.

Time: 40 minutes

Quality inputs:

- Compass
- Ruler

Instructions for the teacher:

Approach:

- Conduct a short discussion about the instruments used in constructions and how the compass and the ruler are used.

Developments of the lesson:

- Follow the steps given below to develop the ability of bisecting an angle in students. While demonstrating by the teacher guide the students to do the constructions.
  (It is necessary that the teacher uses the compass and the ruler.)
- Bisecting an angle

  Step 01 - Draw the angle. Name it $A\hat{B}C$

  Step 02 - Taking a suitable radius on the compass and making B the centre, draw an arc intersecting lines BA and BC. Name the point of intersection D and E.

  Step 03 - Making point D the centre draw an arc again within the angle.

  Step 04 - **Taking the same radius** draw another arc making E the centre so that the arc drawn in steps 3 is intersected.

  Step 05 - Name X the point of intersection of the two arcs and join BX. Explain that line BX is the bisector of $A\hat{B}C$ .Confirm the bisecting of $A\hat{B}C$ by measuring the angles $A\hat{B}X$ and $C\hat{B}X$

- Constructing an angle of 60^0

  Step 01 - Draw a segment of a straight line and name it EF.

  Step 02 - Taking a suitable radius on the compass and making E the centre, draw an arc intersecting lines EF. Name the point of intersection G.

  Step 03 - Taking the same radius used in step 02 above and placing the pointer of the compass on point G draw an arc intersecting the other arc. Name that point H.

  Step 04 - Join EH and produce. Measure the angle $H\hat{E}F$. Show that it is 60^0.

- Constructing of an angle 30^0

  Step 01 - Construct an angle of 60^0. Name it $F\hat{G}H$.

Step 02 - Taking a suitable radius on the compass and making G the centre, draw an arc intersecting lines GF and GH. Name the points of intersection K and L.

Step 03 - Making K and L as centres draw two arcs of equal radii intersecting each other. Name the point of intersection M.

Step 04 - Join GM. Measure angles $F\hat{G}M$ and $H\hat{G}M$. Confirm that $F\hat{G}H$ is bisected by GM and the resulting angle is 30^0

- Construct of an angle 120^0 with students, using the steps used for construction of an ange 60^0.

Assessment and evaluation:

- Assessment criteria:
  - Uses compass and ruler correctly.
  - Involves in the constructions according to instructions given.
  - Bisects an angle given.
  - Confirms the accuracy of the construction.
  - Completes the work patiently according to a plan.
- Direct the students to do the relevant exercises in lesson 13 of the textbook.

For your attention...
Development of the lesson:

- Subsequent to the development of skills relevant to learning outcomes 1 and 2 of competency level 27.2, give an opportunity to develop stepwise the skills of constructing another angles and copying angles.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 13 of the text book.

For further reference:

14. Equations

Competency 17 : Manipulates the methods of solving equations to fulfill the needs of day to day life.

Competency Level 17.1: Easily solves problems in day to day life by solving linear equations.

Competency Level 17.2: Solves problems by using the methods of solving simultaneous equations.

Number of Periods: 06

Introduction:

An equality of two mathematical expressions can be indicated by an equation. An equation with one unknown of power one is a linear equation. This section aims to find the solution of linear equations with two types of brackets in which the coefficients are fractions.
In this section solving of simultaneous equations with equal coefficient is also expected.
The knowledge of solving equations is very important not only in mathematics but also in the learning of other subjects such as science and economics.

Learning outcomes relevant to Competency Level 17.1:

1. Solves linear equations containing algebraic terms with fractional coefficients.
2. Solves linear equations with two types of brackets.

Glossary of terms:

Simple equations	- සරල සමීකරණ	- தெரியாக் கணியம்
Unknown	- අඥාතය	- Unknown
Simultancous equations	- සමගාමී සමීකරණ	- Simultaneous equations

Instructions to plan the lesson:

Given below is a specimen lesson designed to develop in students the learning outcomes 1 under the competency level 17.1

Time: 40 minutes

Quality inputs:

- Copies of the work sheets

Instructions for the teacher:

Approach:

- In order to revise the facts learnt so far about solving linear equations, discuss with students the solving of one of the following types of equations.

  Type $ax + b = c$

  Type $\frac{1}{2}x = c$

  Type $\frac{1}{2}x \pm b = c$

- Also discuss how the accuracy of the solution is checked by substituting the solution in the above equations.

Development of the lesson:

- Distribute work sheet to all the students and engage them in the activity.
- While engage in the activity, move among the students, help them when necessary and assess them.
- Finally discuss students about their findings and reinforce in them how the linear equations carrying algebraic terms with fractional coefficients are solved.

Students' work sheet:

- Writes the terms filling into the blank boxes observing well, the following steps of solving linear equations.

1. $\frac{a}{3} + 2 = 7$

   $\frac{a}{3} + 2 - \square = 7 - 2$

   $\frac{a}{3} \times 3 = 5 \times \square$

   $a = \square$

2. $\frac{3x}{3} - \frac{x}{4} = 10$

   $\frac{x}{3} \times \square - \frac{x}{4} \times 12 = 10 \times \square$

   $\square - \square = 120$

   $x = \square$

3.

4.

3 $\frac{a}{2}+\frac{a}{3}=5$

$\frac{a}{2}\times\square+\frac{a}{3}\times\square=5\times6$ (Multiplying all the terms by the LCM of the denominators.)

$3a+\square=30$

$\square=30$

$\frac{\square}{\square}=\frac{30}{\square}$

$a=.....$

4. $\frac{3x}{3}-\frac{x}{4}=10$

$\frac{x}{3}\times\square-\frac{x}{4}\times12=10\times\square$ (Multiplying all the terms by the LCM of the denominators.)

$\square-\square=120$

$x=\square$

5. Solve the following linear equations following the above steps.

i.) $\frac{x}{3}+\frac{2x}{3}=6$

ii.) $\frac{x}{3}+\frac{x}{4}=7$

- Check the accuracy of your answers by substituting them in the equations.

Assessment and evaluation:

- Assessment criteria:
  - Follows the sequence of steps when solving linear equations.
  - When solving linear equations containing algebraic terms with fractional coefficients, multiply all the terms by the LCM of the denominators
  - Solves linear equations containing algebraic terms with fractional coefficients.
  - Checks the correctness of the solution by substituting the solution in the equation given.
  - Solves problems using the knowledge of linear equations.
- Direct the students to do the relevant exercises in lesson 14 of the textbook.

For your attention...

Development of the lesson:

- In order to establish in students the subject matter relevant to the learning outcome 2 under the competency level 17.1, plan and implement lessons following suitable methods.
- Adopting interesting methods, reinforce in students the subject matter relating to competency level 17.2.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 14 of the text book.

For further reference:

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15. Axioms

Competency 23 : Makes decisions regarding day to day activities based on geometrical concepts related to rectilinear plane figures.

Competency Level 23.1: Geometrically analyses the relationships between quantities.

Number of Periods: 04

Introduction:

The expressions that are already accepted as true without proof are known as axioms. They can be understood correctly without verification. Axioms can be described as an indispensable tool to explain facts logically, to come to conclusions and to build up various relationships in learning mathematics. Under the themes of algebra axioms are often used when solving equations and inequalities. In geometry they are frequently useful in verification and when solving problems with calculations. In subjects such as logic, axioms are used to build up relationships logically and come to conclusions. Though there are many axioms in use, five most frequently used axioms have been identified. This section deals with those five axioms.

Learning outcomes relevant to Competency Level 23.1:

1. Identifies the five basic axioms.
2. Develops relationships using the five basic axioms.

Glossary of terms:

Axioms - ප්‍රතාක්ෂ - கணிதச் செய்கைகள்

Instructions to plan the lesson:

A specimen lesson plan suitable to build up in students subject concepts relevant to the first learning outcome under the competency level 23.1 is presented below. It is proposed that this is implemented on individual basis.

Time: 40 minutes

Quality inputs:

- An enlarge copy of the activity sheet

Instructions for the teacher:

Approach:

- Present the following instances and discuss about the relationship that can be drawn from the information given.
  Price of a pen = Rs. 10, Price of an eraser = Rs. 10
  $\therefore$ Price of a pen = Price of an eraser

- AB = PQ
  AB = XY
  $\therefore$ PQ = XY

- Price of 1 kg of sugar = Rs. 98
  $\therefore$ Price of 5 kg of sugar = Rs. 98 $\times$ 5
- AB = 10 cm
  $\therefore$ 5.AB = 10 $\times$ 5 cm and $\frac{AB}{2}=\frac{10}{2}cm$
- PQ = XY
  $\therefore$ 2PQ = 2.XY and $\frac{PQ}{3}=\frac{XY}{3}$

Development of the lesson:

- Make the students aware of the fact that under each instance they need to study the information given within the box and should write the relationships that can be obtained from the figures or facts given.
- Display the enlarged activity sheet (or draw it on the board) and engage students in the activity individually.
- After completion of the activity, have a discussion with students and explain that the statements which we understand true right away are called axioms.
- Taking into consideration the students' findings and the examples used at the approach, build up the five axioms and ask the students about them.

That is to say,

Axioms 1: The quantities equal to the same quantity are equal themselves.
If a = b and b = c, a = c

Axioms 2: The quantities obtained by adding the same quantity to two equal quantities are equal.
If a = b, a + c = b + c

Axioms 3: The quantities obtained by subtracting the same quantity from two equal quantities are equal.
If a = b, a - c = b - c

Axioms 4: The quantities obtained by multiplying two equal quantities by the same quantity are equal.
If a = b , na = nb

Axioms 5: The quantities obtained by dividing two equal quantities by the same quantity are equal.

If a = b, $\frac{a}{n} = \frac{b}{n}$; where n is not zero

Activity sheet for the students:

- Study the example given in the box in situation 1, 2 and 3 and build up relationships in each according to the information or figure is given.

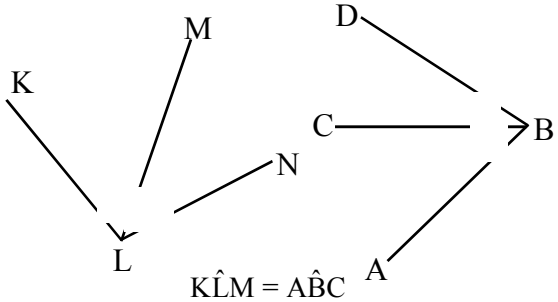
Situation 1

Example:
XY = 5cm
PQ = 5cm
$\therefore$ XY = PQ

AB = BC
AB = AD

Situation 2

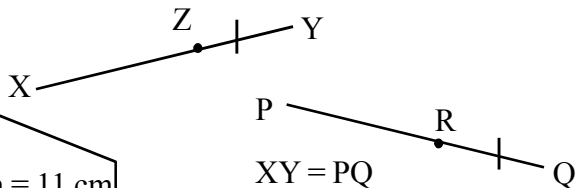
Example:
$P\hat{Q}R = 55^0$
$X\hat{Y}Z = 35^0$
$\therefore P\hat{Q}R + X\hat{Y}Z = 55^0 + 35^0 = 90^0$



$K\hat{L}M = A\hat{B}C$
$M\hat{L}N = C\hat{B}D$

Situation 3

Example:
AB = 15cm
BC = 4cm
AB - BC = 15cm - 4 cm = 11 cm



XY = PQ

Assessment and evaluation:

- Assessment criteria:
  - Writes various relationships that can be derived from the information given.
  - Expresses the opinions of self about the relationships derived by others from the information given.
  - Identify expressions that clearly appear to be true as axioms.
  - Describe five basic axioms.
  - Accepts that identification of axioms is very important in mathematics.
- Direct the students to do the relevant exercises in lesson 15 of the textbook.

For your attention...
Development of the lesson:

- Direct students to do exercises on building up various relationships using axioms in relation to the learning outcome 2 under the competency level 23.1.
- Build up and present other appropriate examples.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 15 of the text book.

For further reference:

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16. Angles of a Triangle

Competency 23 : Makes decisions regarding day to day activities based on geometrical concepts related to rectilinear plane figures.

Competency Level 23.2: Formally investigates the sum of the three interior angles of a triangle.

Competency Level 23.3: Investigates the relationship between the exterior angle formed by producing a side of a triangle and the interior opposite angles.

Number of Periods: 09

Introduction:

The theorem "The sum of the interior angles of a triangles is equal to 180^0" is a fundamental theorem. In most of the instances in the future this theorem has to be made use of in geometry. Therefore, it is very important to verify this theorem and understand its validity and in this section this aspect is discussed. In this section , it is also expected to verify the theorem " the exterior angle formed by producing aside of a triangle is equal to the sum of the two interior opposite angles" and discuss its applications. So, in the calculations relating to triangles, these theorem can be used.

Learning outcomes relevant to Competency Level 23.2:

1. Identifies the theorem, "The sum of the three interior angles of a triangle is 180º".
2. Verifies the theorem, "The sum of the three interior angles of a triangle is 180º".
3. Solves simple geometric problems using the theorem, "The sum of the three interior angles of a triangle is 180º".

Glossary of terms:

Triangle	-	ත්‍රිකෝණය	-	முக்கோணம்
Interior angles	-	අභ්‍යන්තර කෝණ	-	அகக்கோணங்கள்
Theorem	-	ප්‍රමේයය	-	தேற்றம்
Verification	-	සත්‍යාපනය	-	வாய்ப்புப்பார்த்தல்

Instructions to plan the lesson:

A specimen lesson planned to introduce and verify the theorem "The sum of the interior angles of a triangles is equal to 180^0" relevant to learning outcomes 1 and 2 under the competency level 23.2 adopting the lecture-discussion method with an activity in pairs is presented below.

Time: 40 minutes

Quality inputs:

- Copies of the work sheet

Instructions for the teacher:

Approach:

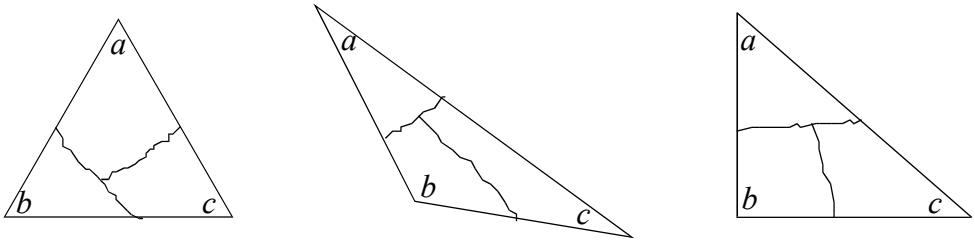
- Recall again about the magnitudes of the acute angles, obtuse angles and straight angle learnt before.
- Recall that the sum of the adjacent angles meeting at a point on a straight line is equal to 180^0.

Development of the lesson:

- Introduce the theorem "The sum of the interior angles of a triangles is 180^0" by writing it on a panel and displaying it.
- Tell students that they are going to do an activity in pairs to verify the above theorem.
- Display an enlarge copy of the work sheet in front of the class.
- Engage all the students in the activity in pairs.
- After completing the activity, elicits from the students that according to the result the sum of the three interior angles of a triangle is 180^0 irrespective of its type.
- Instruct to confirm what they have discovered by drawing another type of a triangle different from the previous and measuring its angles.

Activity sheet for the students:

- Draw any one of the following types of triangles of your choice on a paper.



- Label as a, b and c the three angles of the triangle you have drawn.
- With the help of your friend separate the triangle in to three parts each with an angle.
- Paste the parts so that their vertices meet at a point touching their arms and see whether a straight line is obtained.
- So, discuss with your friend that by this method, the theorem "The sum of the interior angles of a triangles is 180^0" can be verified.

Assessment and evaluation:

- Assessment criteria:
  - Draw an acute-angled, obtuse-angled and right-angled triangles.
  - State that their angles lie on a straight line when pasted so that their vertices meet.
  - Accepts that, whatever the type of the triangle, the sum of their three interior angles is 180^0.
  - Engage in an activity to come to a conclusion through a generalisation.
  - Shares the results obtained with the others.
- Direct the students to do the relevant exercises in lesson 16 of the textbook.

For your attention...

Development of the lesson:

- After verifying that the sum of the three interior angles of triangle is 180^0, engage in exercises applying it.
- Include into exercises, various types of triangles as well as triangles with parallel lines learnt before.
- Design and implement lesson plan to achieve the learning outcomes relevant to the competency level 23.3.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 16 of the text book.

For further reference:

- http://www.youtube.com/watch?v=hmj3_zbz2eg
- https://www.youtube.com/watch?v=6s1CI3uuhko
- http://www.youtube.com/watch?v=0gzSreH8nUI

17. Formulae

Competency 19 : Explores the methods by which formulae can be applied to solve problems encountered in day to day life.

Competency Level 19.1: Changes the subject of a formula that has been developed to show the relationship between variables.

Number of Periods: 06

Introduction:

- The general relationship existing between two or more quantities is a formula.
- In a formula, when one quantity becomes equal to other quantities organised in an order, that single quantity is referred to as the subject of the formula.
- Formulae are used in subjects like mathematics and science as well as in other subjects. In calculations, one variable has to be made the subject according to the need
- In this section it is expected to change the subject of formula without powers and roots and substitute value for an unknown in a simple equation and simplify.

Learning outcomes relevant to Competency Level 19.1:

1. Changes the subject of a formula that does not contain squares and square roots.
2. Performs calculations by substituting values for the unknowns in a simple formula.

Glossary of terms:

Formula	- සූත්‍රය	- செங்கோண முக்கோணி
Subject	- උක්තය	- செம்பக்கம்
Unknown	- අඥාතය	- பைதகரசின் தேற்றம்
Substitution	- ආදේශය	- பைதகரசின் மும்மை
Quantity	- රාශිය	- பைதகரசின் மும்மை

Instructions to plan the lesson:

Given below is a specimen lesson that adopts lecture discussion method to achieve the first learning outcomes relevant to competency level 19.1

Time: 40 minutes

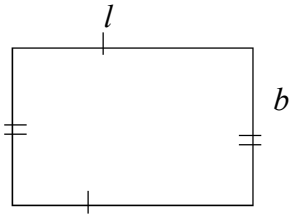
Quality inputs:

- Copies of the activity sheet
- Kits of the cards prepared according to annex I
- Half sheets

Instructions for the teacher:

Approach:

- If p is the perimeter of a rectangle of length l and breadth b, $p = 2(l+b)$. if the area of the above
- r ectangle is A, A = lb



- Presenting formulae such as above, introduce that the single algebraic term on one side of a formula is the subject of the formula.
- Explain that it is required to change the subject during calculations according to the situation.
- Recall giving examples how axioms are used when solving equations.

Development of the lesson:

- Group the students as appropriate.
- Distribute activity sheets, card kits and half sheets among the groups.
- Move among the groups while they are at work and give necessary instructions.
- After completion of work, discuss with students how the unknown is made the subject of the given formulae.
- Discussing with students explain how the subject is change in an equation with parentheses such as $S = 180(n-2)$, $S=\frac{n}{2}(a+l)$, $S=\frac{2}{5}(a+b)$

Activity sheet for the students:

Group 1	Group 2	Group 3
$v = u + ft \quad (t)$	$y = mx + c \ \ (x)$	$A = 2\pi rh + a(h)$

- Observe carefully the term to be made the subject opposite the formula given to your group and the set of cards.
- In order to make the term given inside parentheses opposite the formula the subject, arrange the set of cards in the correct order.
- Write the order you prepared in the half sheet.

Assessment and evaluation:

- Assessment criteria:
  - Identifies the subject of a given formula.
  - Identifies the correct order that should be used to make a given term the subject of a formula.
  - Makes given term in a formula the subject of it.
  - Sees the relationship among the terms of a given formula.
  - Involves in the given task following the correct steps.
- Direct the students to do the relevant exercises in lesson 17 of the textbook.

For your attention...

Development of the lesson:

- Following appropriate methods, develop in students the learning outcome 2 relevant to competency level 19.2.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 17 of the text book.

For further reference:

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Annex I

Group 1	Group 2	Group 3
$v = u + ft$	$y = mx + c \ (x)$	$A = 2\pi rh + a$
$\frac{v-u}{f} = \frac{ft}{f}$	$\frac{y-c}{x} = m$	$A - a = 2\pi rh + a - a$
$v - u = u + ft - u$	$y - c = mx + c - c$	$\frac{A-a}{2\pi r} = \frac{2\pi rh}{2\pi r}$
$\frac{v-u}{f} = t$	$\frac{y-c}{x} = \frac{mx}{x}$	$\frac{A-a}{2\pi r} = h$
$v - u = ft$	$y - c = mx$	$A - a = 2\pi rh$

18. Circumference of a Circle

Competency 7 : Investigates the various methods of finding the perimeter to carry out daily tasks effectively.

Competency Level 7.1: Applies the relationship between the diameter and circumference of a circle when performing various calculations.

Number of Periods: 05

Introduction:

Most of the objects that come across our day to day life are round or circular shapes. So it is important to know the relationship between the circumference and diameter. Discuss the following concepts according to the competency level 7.1. For any circle the ratio between the circumference and the diameter is nearly around 3 and is named as . For calculations we assumed the value of π as $\frac{22}{7}$ or 3.14. Through this competency level it is expected to develop the skill to solve the problems relating circumfarane of a circle.

Learning outcomes relevant to Competency Level 7.1:

1. Measures the diameter and the circumference of circular laminas using various methods.
2. Develops a formula for the circumference by considering the relationship between the diameter and the circumference of a circle.
3. Performs calculations related to the circumference of a circle by applying the formulae $c = \pi d$ and $c = 2\pi r$.
4. Finds the circumference of a circle.
5. Finds the perimeter of a semi-circle.
6. Solves simple problems involving the circumference of a circle.

Glossary of terms:

Circle	-	වෘත්තය	-	வட்டம்
Circumference	-	පරිධිය	-	பரிதி
Diameter	-	විෂ්කම්භය		-விட்டம்
Radius	-	අරය	-	ஆரை

Instructions to plan the lesson:

Given below is an exemplar lesson plan to achieve the learning outcomes 1, 2 and 3 of competency level 7.1 using group activity method.

Time: 40 minutes

Quality inputs:

- Measuring tape
- Cicular discs with differant sizes
- A4 sheets
- Calculator
- Pair of scissors

Instructions for the teacher:

Approach:

- Discuss about finding the perimeter of rectilinear plane figures.
- Begin the lesson discussing about method of measuring the circular lengh of a circular object.

Development of the lesson:

- Divide the class into groups according to the number of students.
- Give a copy of activity sheets, three different size circular discs, a measring tape, A4 sheets, a calculator, a pair of scissors to every group.
- Give time to the students to present their findings
- During the presentation, pay attention to the value of the ratio between the circumference and the diameter of a circle.
- Stress the above value is near to three.
- Make the student clear that the above ratio is named as π and its value is assumed as 3.14 or $\frac{22}{7}$ for calculation.
- Make clear the above ratio is true for any circle.
- Make clear about the formula $\frac{c}{d} = \pi$ from their discovery and discuss about the different forms of the formular such as $c = \pi d$ and when $d = 2r$ is given $c = 2\pi r$.
- Tell the students to use the formula in solving problems relating to the circumfrance of the circle.

Activity Sheet for the Students :

- Mark a point on the edge of the circular discs (different sizes).
- Draw a straight line on the paper give and mark a point on the straight line.
- By holding the disc vertically put the point on the straight line such that coinciding the two points on the edge of the disc and the straight line.
- Now roll the disc along the line.
- When the point on the disc touches the straight line again mark the touching point on the straight line.
- Measure the distance between the two points on the staight line.

- Put the disc on a paper and draw the outline of it.
- Cut and seperate the outline you drew and by folding symmetrically find the diameter of the disc.
- Using the measures you have fill the following table.

Circular discs	circumfrance (c)	diameter (d)	$\frac{c}{d}$
i. ..... ii. ..... iii.			

- Find the value of $\frac{c}{d}$ using calculator.
- What dicesion you can make with your calculations.
- Present your findings to the class.

Assessment and evaluation:

- Assessment criteria:
  - Measures the circumference of the disc accurately.
  - Measures the diameter of the disc accurately.
  - Express the ratio between the circumference and the diameter is nearly 3.
  - Works cooperatively within the group.
  - Finishes the work on time.
- Direct the students to the relevant exercises in lesson 18 of the text book.

For your attention...

- Organise activities to achieve the learnig out comes 4, 5 and 6 of competency level 7.1.

Assessment and evaluation:

- Direct the students to the relevant exercises in lesson 18 of the text book.

For further reference:

- hhttp://www.youtube.com/watch?v=04N79tItPEA
- http://www.youtube.com/watch?v=jyLRpr2P0MQ

For teachers only .....

It came to know that in ancient times mankind had the knowledge about the ratio between the circumference and the diameter of a circle. Ludolph Van ceulen (1540-1610) calculated the value of π to 35 decimal points.

Archemedes (287- 212 BC) calculated the value of π lies between $3\frac{10}{71}$ and $3\frac{1}{7}$. Now the value of π is calculated to million decimal points by the computer.

19. Pythagoras Relationship

Competency 23 : Makes decisions regarding day to day activities based on geometrical concepts related to rectilinear plane figures.

Competency Level 23.5: Applies Pythagoras' relationship to solve problems in day to day life.

Number of Periods: 04

Introduction:

The side opposite the right angle in a right angled triangle is called hypotenuse. It is the longest side of the triangle. In sixth century B.C., the Greek mathematician Pythagoras had presented for the first time a relationship among the side of a right angled triangle. The relationship states that in any right angled triangle the area of the square drawn on the hypotenuse is equal to the sum of the areas of the squares drawn on the other two sides of the triangle.

In this section it is expected to veify Pythagoras' relationship for whole number values , to solve simple problems using the subject content related to the Pythagoras relationship and to use Pythagoras relationship to solve various problems relating to the practical life.

Learning outcomes relevant to Competency Level 23.5:

1. Identifies Pythagoras' relationship.
2. Verifies Pythagoras' relationship.
3. Solves simple problems by applying Pythagoras' relationship.
4. Solves problems in day to day life by applying the subject content related to Pythagoras' relationship.

Glossary of terms:

Right angle	-	සෘජුකෝණය	-	திசை
Diagonal	-	කර්ණය	-	தூரம்
Pythagoras' relationship	-	පයිතගරස් සම්බන්ධය	-	அமைவு
Right angle triangle	-	සෘජුකෝණී ත්‍රිකෝණය	-	பரும்படி படம்

Instructions to plan the lesson:

This aims to establish in students the subject matter relevant to the fourth learning outcome following the achievement of subject content relating to learning outcomes 1, 2 and 3 under the competency level 23.5. Given below is a specimen that involves students in an outdoor activity for this.

Time: 40 minutes

Quality inputs:

- 30 m measuring tapes (one for each group)
- Hammer (one for each group)
- Ropes
- 5" iron nails (10 for each group)
- Copies of the activity sheet

Instructions for the teacher:

Approach:

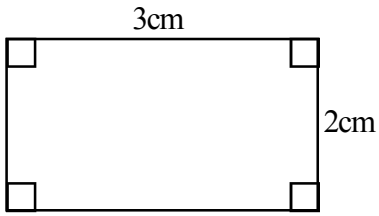
- Recall Pythagoras relationship explaining that the area of the square drawn on the hypotenuse of a right angled triangle is equal to the sum of the areas of the squares drawn on the other sides using either a diagram or Pythagoras triads.
- Inform students that how Pythagoras relationship is applied in practical life and how problems related to it are solved will be explored.

Development of the lesson:

- Divide the class into groups of six as appropriate.
- To each group give an activity sheet, a hammer, ten 5" iron nails, enough ropes and a 30 m measuring tape.
- Assign different places in the outdoor for the groups.
- Orient the students to the activity giving instructions to position the true figure given on the earth.
- At the end of the student activity, measure the lengths of the diagonal of the rectangle and asking the accuracy of the placement of the rectangle make a review.

Activity sheet for the students :

- Observe the following diagram. Fill in the blanks using the scale given.



scale 1:300

- The name by which this figure is known is .....
- The true length of this is .....
- The true breadth of this is .....

- The vertex angle of this figure is .....
- According to the measurements you obtained and the scale given, place that figure on earth. Use the measuring tape, hammer, ropes, iron nails provided to you for this.
- State an instance where you used subject content related to the Pythagoras relationship when you are installing the above figure on earth
  .....
- Name two instances wheresubject content related to the Pythagoras relationship is practically used in real life.
  1. .....
  2. .....

Assessment and evaluation:

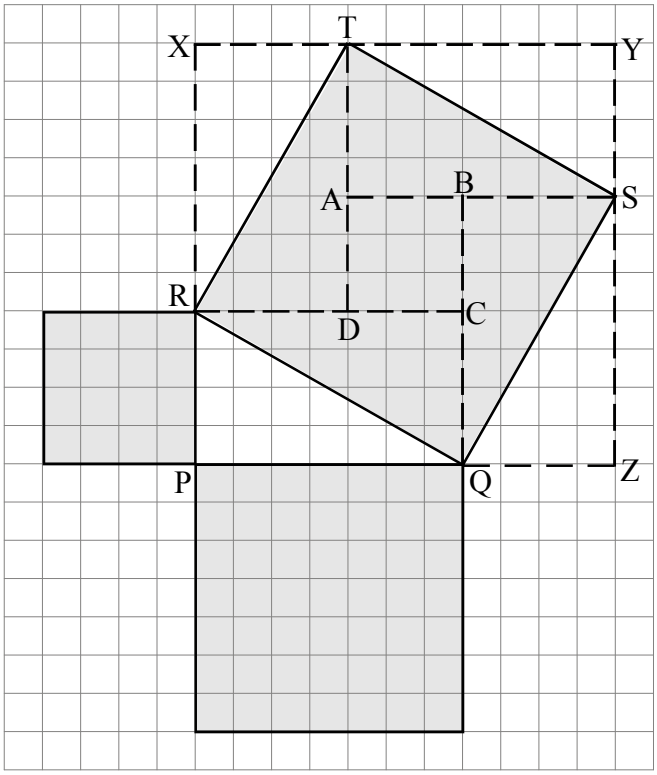
- Assessment criteria:
  - Fills in the blanks according to information given.
  - Accepts that a rectangle can be correctly obtained using the subject content related to the Pythagoras relationship.
  - Explains the importance and need of the subject content related to the pythagoras relationship when positioning a rectangle or square on earth.
  - Accepts the convenience of working together in a group.
  - Complete the assigned task within a given period of time.
- Direct the students to do the relevant exercises in lesson 19 of the textbook.

Practical sifuations:

- Discuss with students an occasion such as placing the plan of a house on ground or construction of a volleyball or netball court.

For your attention.....

- Plan and implement activities as follows to verify Pythagoras relationship in relation to the learning outcome 2.
- Draw a right angled triangle on a square ruled paper and draw squares on all the three sides of it.



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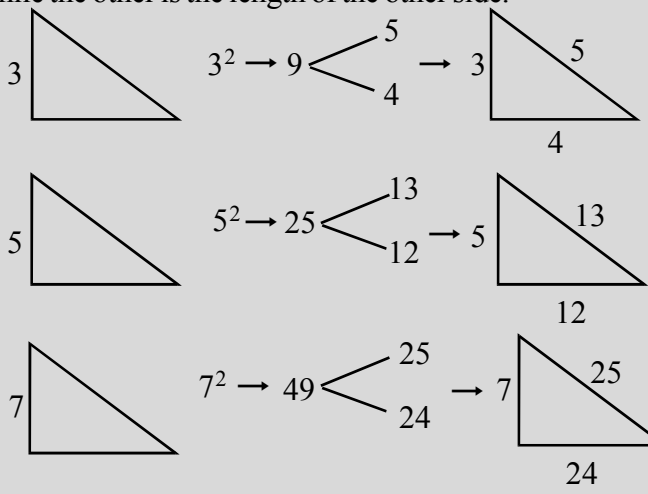
- PQR is the right angled triangle.
- According to the measurements given in the figure length of PR is 4 squares, length of PQ is 7 squares.
- Draw PXYZ square so that PR = QZ and PQ = RX.
- As in the figure below , draw the rectangles RXTD, TYSA, BSZQ and PQCR so that PR and PQ are length and breadth.
- Obtain the square RTSQ by joining the diagonals (RT, TS, SQ, RQ) of those rectangles.
- Confirm Pythagoras relationship using the number of squares in the squares drawn on the sides of the right angled triangle.
- Guide the students to explore different methods to verify the truth of Pythagoras relationship . Using it, instruct students to prepare a portfolio of learning as a method of school -based learning.

For further reference:

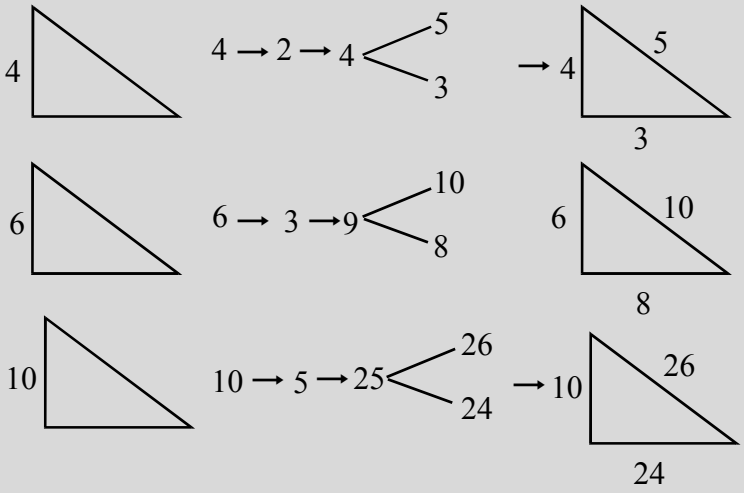
- http://www.youtube.com/watch?v=s9t7rNhaBp8
- http://www.youtube.com/watch?v=AEIzy1kNRqo
- https://www.youtube.com/watch?v=JVrkLIcA2qw

Only for the teacher...

- Given below is a method which can be used to genarate Pythagoras triads.
  - When the length of a side of a right angled triangle except the hypotenuse is an odd number,
    - Take the odd number length of a smaller side of the triangle.
    - Square it.
    - Divide the number that was squared to two consecutive numbers so that their sum is equal to the number squared.
    - of the two consecutive numbers, the large number is the hypotenuse while the other is the length of the other side.



  - When the length of a side of a right angled triangle except the hypotenuse is an even number,
    - Take the even number length of a smaller side of the triangle.
    - Take exactly half of it.
    - Square it.(the halved number)
    - Take the two numbers, one greater than and one less than the number obtained by squaring.



20. Graphs

Competency 20 : Easily communicates the mutual relationships that exist between two variables by exploring various methods

Competency Level 20.1: Analyses graphically mutual linear relationship between two variables.

Number of Periods: 07

Introduction:

In a straight line graph the equation of the function is given as $y = mx + c$. In this m is known as the gradient of the graph and c is called the intercept. Under this section it is expected to discuss about the identification of gradient and intercept in a graph of the form $y = mx + c$, the behaviour of the graph when the gradient and the intercept change, gradients of straight line graphs that are parallel to one another and drawing a graph of a function of the form $ax + by = c$.

Learning outcomes relevant to Competency Level 20.1:

1. Identifies that the relationship between x and y given by a linear equation in and is a function.
2. Draws the graph of a function of the form $y = mx$.
3. Draws the graph of a function of the form $y = mx + c$.
4. Explains how the graph of a function changes depending on the sign and magnitude of the gradient .
5. States that is the gradient and is the intercept of the graph of a function of the form $y = mx + c$.
6. Writes down the gradient and the intercept of the graph of a function of the form $y = mx + c$ by examining the function.
7. Draws the graph of a function of the form $ax + by = c$ for a given domain.
8. Analyses the gradients of straight line graphs which are parallel to each other.

Glossary of terms:

Graph	-	ප්‍රස්තාරය	-	வரைபு
Gradient	-	අනුක්‍රමණය	-	படித்திறன்
Intercept	-	අන්තඃඛණ්ඩය	-	வெட்டுத்துண்டுIntercept
Function	-	ශ්‍රිතය	-	சார்பு
Parallel	-	සමාන්තර	-	சமாந்தரம்

Instructions to plan the lesson:

Given below is a specimen lesson adopting group work and lecture -discussion method to achieve learning outcomes 4, 5 and 6 after reinforcing in students the subject matter relevant to learning outcomes 1, 2 and 3 under the competency level 20.1

Time: 40 minutes

Quality inputs:

- Copies of the activity sheet
- Coordinate planes prepared with x and y axes extending from -6 to +6

Instructions for the teacher:

Approach:

- Recall how the values of y is obtained by substituting values for x in an equation of the form $y = 2x$ showing the relationship between y and x.
- Recall how the values of y are obtained by substituting values within the range $-1 \leq x \leq 2$ in an equation such as $y = 3x + 2$.
- Recall how a straight line graph is drawn on a coordinate plane.

Development of the lesson:

- Divide the students into group as appropriate.
- Give students the activity sheets and coordinate planes prepared.
- Engage students in the activity as indicated in the activity sheet.
- After completion of the activity, conduct a discussion eliciting findings to surface following facts.
  - In an equation of the form $y = x$ or $y = mx + c$, the graph forms an acute angle with the positive direction of x axis when the coefficient of x is positive while an obtuse angle with positive direction of x axis when the coefficient of x is negative.
  - In a straight line graph of an equation of the form $y = x$ or $y = mx + c$, when the value of $m>0$ and increase, the angle formed by that line and the positive direction of the x axis increases.
  - They coordinate of the point at which the graph intersects the y axis is the intercept of the graph.
- In an equation presented in the form $y = mx + c$, m indicates the gradient while c represents intercept.
- At the end of the lesson present several equations of the form $y = mx + c$. Observing them and questioning about gradient and intercept , lead a discussion.

Activity sheet for the students :

I	II	III	IV
$y = 2x$ $y = 4x - 1$ $y = -3x + 2$	$y = 4x$ $y = 3x - 2$ $y = -2x + 2$	$y = 2x$ $y = -3x + 1$ $y = 2x - 3$	$y = 3x$ $y = -2x + 2$ $y = 2x - 3$

- Pay attention to the pair of equations you have got.
- Substitute suitable values for x, find the corresponding value of y and draw their graphs on the coordinate plane provided.
- Observing the graphs drawn by your group answer the following questions.
  - Will the angle formed by the graph with axis increase or decrease when the coefficient of x in the equation increases positively?
  - Is the angle formed by the graph with x axis an acute angle or obtuse angle when the coefficient of x is negative?
  - What is the relationship between the coordinates of y and the constant term of the equation at the pont at which the graph relating to second and third equations you have got intersect y axis.

Assessment and evaluation:

- Assessment criteria:
  - Accepts that in a function of the form $y = mx + c$, when the value of $m>0$ and increases, the angle formed by the graph with the positive direction of x axis increases.
  - States the gradient and intercept of the graph of a given function.
  - States that in a function of the form $y = mx + c$, when the value of m is positive, the angle formed by the graph with the positive direction of x axis is an actue angle.
  - States the gradient and the intercept of the grsph of a given function without drawing the graph.
  - Complete the assigned task within a given period of time.
- Direct the students to do the relevant exercises in lesson 20 of the textbook.

For your attention...

Development of the lesson:

- Plan and implement suitable lession to develop in students subject concepts relavant to learning outcomes 7 and 8 under competency level 20.1.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 20 of the textbook.

For further reference:

- http://www.youtube.com/watch?v=0eWm-LY23W0
- http://www.youtube.com/watch?v=LoKEPEPaNm4
- http://www.youtube.com/watch?v=qo5jU_V6JVo
- http://www.youtube.com/watch?v=KV_XLL4K2Fw

21. Inequalities

Competency 18 : Analyzes the relationships between various quantities related to real-life problems.

Competency Level 18.1: Uses the relationship between two quantities to solve problems.

Number of Periods: 03

Introduction:

In the use of quaantitative values we encounter in our day to day life, very often we need to indicate greatness, lessness or equality. In mathematics following symbols are used for these.

Meaning	Symbol
Equal to	$=$
Greater than	$>$
Less than	$<$
Either greater or less than	$\gtrless$
Either less than or equal to	$\leqslant$
Either greater than or equal to	$\geqslant$
Greater than or less than or equal to	$\lessgtr$

It is required to have solutions not only for equations but also for inequalities. This section explains how algebraic methods and number line are used for this purpose.

Learning outcomes relevant to Competency Level 18.1:

1. Solves inequalities of the form $x \pm a \lessgtr b\,(a, b \in \mathbb{Z})$.
2. Solves inequalities of the form $ax \lessgtr b$ when $a > 0$.
3. Solves inequalities of the form $ax \lessgtr b$ when $a<0$
   (a; $a \neq 0$ is an integer or a fraction)
4. Represents the integral solutions of an inequality on a number line.
5. Represents the solutions of an inequality on a number line.

Glossary of terms:

Inequality	-	අසමානතාව	-	சமனிலி
Equal	-	සමාන වේ	-	சமன்
Greater than	-	විශාල වේ	-	பெரிது
Less than	-	කුඩා වේ	-	சிறிது

Instructions to plan the lesson:

Given below is a specimen lesson that adopts guided inquiry method to develop in students the skill of solving inequalities relevant to the learning outcome 1 under the competency level 18.1.

Time: 40 minutes

Quality inputs:

- Copies of the activity sheet (one for each student)

Instructions for the teacher:

Approach:

- Recall the meaning of the following symbols learnt in grade 6 and 7.
  $=, >, <, \geq, \leq$
- Show that the values 4, 5, 6, ... fit in for x when $x > 3$
- Write the equations $x + 2 = 7$ and $x - 1 = 5$ on the board and solve them while discussing with students.
- Show that instead of the inequality in above equations, relationships with inequality signs may also exist.
- Have access to the lesson pointing out the need of solving a relationship with such an inequality.

Development of the lesson:

- Distribute a copy of the activity sheet to every student.
- Direct the students to act according to the instructions given in it.
- Move among the students and give necessary assitance and instructions.
- After completion of the activity, make review eliciting responses randomly.
- During the review, explain if an inequality has a maximum or minimum whether an inequality is characterised by a maximum or minimum.
- At the end of the review give a note that describes how a relationship with an inequality is solved to be entered in the exercise books.

Activity sheet for the students :

- Solve the algebraic inequalities given in verbal clauses in the following table applying your knowledge of solving simple equations and studying the following examples.

Example (i)

$x + 2 \geq 5$

$x + 2 - 2 \geq 5 - 2$ (use of axioms)

$x \geq 3$

The set of whole numbers which is the solution of $x = \{3, 4, 5, 6, ...\}$

Example (ii)

$x - 2 < 1$

$x - 2 + 2 < 1 + 2$ (use of axioms)

$x < 3$

The set of positive whole numbers which is the solution of $x = \{2, 1\}$

- Rows A and B have been completed. Studying them complete the rest of the table.

	Statement	When wtitten in algebraic form	Possible whole numbers for x	Values which x can assume	
				Maximum (If exist)	Minimum (If exist)
A	When 2 is added to the number presented by x, 5 is obtained.	$x + 2 = 5$	3	-	-
B	The sum of the number represented by x and 2 is either greater than or equal to 5	$x + 2 \geq 5$	3,4,5,6,...	No	3
i	The sum of the number represented by x and 5 is either greater than or equal to 8				
ii	9 is greater than the answer obtained by sub-tracting 2 from the number represented by x				
iii	The answer obtained by subtracting by 3 from the number represented by x is either equal to or greater than 10				

Assessment and evaluation:

- Assessment criteria:
  - Writes the set of solutions that can be assumed by the algebraic term in an inequality.
  - Writes the maximum and minimum value that can be assumed by the algebraic term in an inequality.
  - Accepts that an inequality has more than one solutions.
  - Solves inequalities using the algebraic method of solving simple equations.
  - Complete the task following the instructions given.
- Direct the students to do the relevant exercises in lesson 21 of the textbook.

For your attention...

Development of the lesson:

- Plan and implement suitable lessons to develop in students subject concepts relevant to learning outcomes 2, 3, 4, and 5 under the competency level 18.1

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 21 of the textbook.

For further reference:

- http://www.youtube.com/watch?v=nFsQA2Zvy1o

22. Sets

Competency 30 : Manipulates the principles related to sets to facilitate daily activities.

Competency Level 30.1: Performs set operations by identifying various systems.

Number of Periods: 07

Introduction:

- Students have already learnt to identify a set and to write the elements of a set. The sets in which the number of elements can be indicated by a definite number are **finite sets**. The sets whose number of elements cannot be indicated by a definite number are **infinite sets**.
- The sub sets of a given set are the sets written by picking up one or more elements of that set , null set and the same set itself.
- If *n* is the number of elements in a set, it is maximum number of subsets is 2^n.
- The sets with similar elements are **equal sets** whereas the sets with equal number of elements are **equivalent sets**. Therefore equal sets always equivalent sets but equivalent sets are always not equal sets.
- A set included elements of a set or sets is the **universal set** of those sets.
- The set that includes all the elements in the sets A and B is the **union of set** A and B and is given the notation $A \cup B$.
- The set that includes the elements common to two sets A and B is the **intersection set** of A and B is given the notation $A \cap B$.
- The sets in which the intersection is a null set are disjoint sets.
- The set that indicates the elements in the relevant universal set except the elements of set A is the **complement** of set A. It is given the notation $A^{/}$.

This section deals with the subject concepts related to the sets described above.

Learning outcomes relevant to Competency Level 30.1:

1. Identifies finite sets and infinite sets.
2. Concludes with reasons whether a given set is a finite set or an infinite set.
3. Writes down all the subsets of a given finite set.
4. Explains the difference between equivalent sets and equal sets.
5. Identifies disjoint sets.
6. Identifies the universal set.

7. Writes down the elements in the intersection of two sets.
8. Writes down the elements in the union of two sets.
9. Identifies the complement of a set.
10. Identifies the symbols relevant to set operations.
11. Accepts that if the intersection of two sets is the empty set, then the two sets are disjoint.
12. Solves problems using the knowledge on sets.
13. Represents subsets, the intersection of two sets, the union of two sets, disjoint sets and the complement of a set in Venn diagrams and writes these sets using the symbols used for set operations. (For two sets only)

Glossary of terms:

Finite sets	-	පරිමිත කුලක	- முடிவுள்ள தொடைகள்
Infinite sets	-	අපරිමිත කුලක	- முடிவில் தொடைகள்
Sub sets	-	උපකුලක	- உபதொடைகள்
Equivalent sets	-	තුල්‍ය කුලක	- சமவலுத் தொடைகள்
Equal sets	-	සමකුලක	- சம தொடைகள்
Disjoint sets	-	වියුක්ත කුලක	- மூட்டற்ற தொடைகள்
Union of sets	-	කුලක මේලය	- தொடை ஒன்றிப்பு
Intersection of sets	-	කුලක ඡේදනය	- தொடை இடைவெட்டு
Complement of a set	-	කුලකයක අනුපූරකය	- நிரப்பித் தொடை

Instructions to plan the lesson:

Given below is a specimen lesson prepared adopting the lecture-discussion method with a group activity to develop in students the subject concepts related to the learning outcomes 1 and 2 under the competency level 30.1.

Time: 40 minutes

Quality inputs:

- Copies of the activity sheet

Instructions for the teacher:

Approach:

- Start discussion by recalling previous knowledge and asking what is a set.
- Display the sets,

  X = {even numbers between 0 - 10}

  Y= {multiples of 3 between 0 - 25}

  on the board. Continue the discussion asking about the elements of X and Y.

Development of the lesson:

- Divide the class into groups of four, give a copy of the activity sheet to each group and engage the students in the activity.
- Once the activity is over, displays the findings of each group on the board.
- After the students' presentations, conduct the discussion highlighting the following.
  - Can all the elements of the set A and b be written or not? Can the number of all the elements in sets A and B be stated definitely or not?
  - Can all the elements of the sets C and D be written or not? Can the number of all the elements in sets C and D be stated definitely or not?
  - The sets in which the number of elements can be given by a definite quantitative value are called finite sets.
  - The sets in which the number of elements cannot be given by a definite quantitative value are called infinite sets.
- Display some other finite and infinite sets on the board and reinforce the concept in students by asking to what type those sets belong.

Activity sheet for the students :

- If can write all elements of the following sets, write the elements of the sets and the number of elements in each.
  If can't write all elements of the sets, write some of elements of these sets and put dotted line. As well as, indicate the sentence "can't tell" instead the number of elements in each.

  (i) A = { odd numbers between 0 - 10 }

  A = { } Number of elements in A = ☐

  (ii) B = {multiples of 5 between 0 -50}

  B = { } Number of elements in B = ☐

  (iii) C = {multiple of 2 }

  C = { } Number of elements in C = ☐

  (iv) D = { counting numbers }

  D = { } Number of elements in D = ☐

- Display the facts you found on the board.

Assessment and Evaluation:

- Assessment criteria:
  - Writes the elements and the number of elements in a given finite set.
  - Identifies as finite sets the sets whose number of elements can be given by a definite quantitative value.
  - Identifies as infinite sets the sets whose number of elements cannot be given by a definite quantitative value.
  - Acts cooperatively within the group.
  - Completes the work within the allocated time.
- Direct the students to do the relevant exercises in lesson 22 of the textbook.

For your attention...

Development of the lesson:

- Plan and implement an activity to enable students to write the sub sets of a given sub set.
- Introduce equal sets and equivalent sets and conduct an activity to explain the difference between them.
- Adopt a suitable activity to introduce the universal set, intersection of sets, union of sets and disjoint sets.
- Plan and implement and activity suitable to introduce the complement of a set.
- Design and implement activities to illustrate sets, sub sets, intersection of two sets, union of sets, complement of a set and disjoint set by Venn diagrams.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 22 of the textbook.

For further reference:

- http://www.youtube.com/watch?v=jAfNg3ylZAI

23. Area

Competency 08 : Makes use of a limited space in an optimal manner by investigating the area.

Competency Level 8.1: Investigates the area of simple geometrical shapes in the environment.

Number of Periods: 05

Introduction:

The extent of a given surface is called its area. In previous grades it is learnt how to derive formulae to find the areas of the plane figures squares, rectangles and triangles and find areas of such figures using them. In this grade it is expected that the student will derive formulae to find the areas of the plane figures bounded by parallelogram, trapeziums and circles and find areas of such shapes.

Learning outcomes relevant to Competency Level 8.1:

1. Develops a formula for the area of a parallelogram.
2. Finds the area of a parallelogram.
3. Develops a formula for the area of a trapezium.
4. Finds the area of a trapezium.
5. Develops the formula $A = \pi r^2$ for the area A of a circle.
6. Performs calculations by applying the formula $A = \pi r^2$.
7. Solves problems related to the areas of parallelograms, trapeziums and circles.

Glossary of terms:

Parallelogram	-	සමාන්තරාස්‍රය	-
Trapezium	-	ත්‍රාපීසියම	-
Circle	-	වෘත්තය	-

Instructions to plan the lesson:

Given below is a specimen lesson designed with the adoption of discussion method coupled with an individual activity for developing in students the subject matter related to the learning outcomes 1 and 2 under the competency level 8.1.

Time: 40 minutes

Quality inputs:

- Copies of the activity sheet
- Glue/pairs of scissors/squared ruled papers

Instructions for the teacher:

Approach:

- Ask what is area and discuss about the formulae used to find the area of a square and rectangle in previous grades.
- Draw a few figures on the chalk board as appropriate and let the students find the area of the rectangle.
- Surface through the discussion that the areas of the plane figures that overlap are equal.

Development of the lesson:

- Divide the class into groups and to each group distribute quality input materials adequately.
- Let the students know that they should do the activity individually and assess them while assisting as required.
- After completion of the activity, conduct a discussion and reinforce learning outcomes 1 and 2

Activity sheet for the students :

Part A

Cut two parallelogram shapes the size in Figure 1 from a square ruled paper

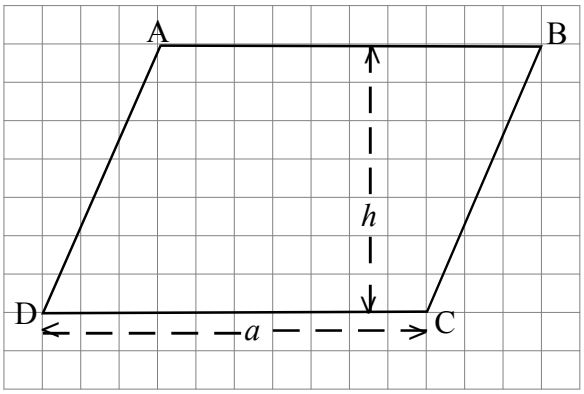


Figure 1

- In one of the parallelograms cut, draw a triangular part as in Figure 2 and snip it out.

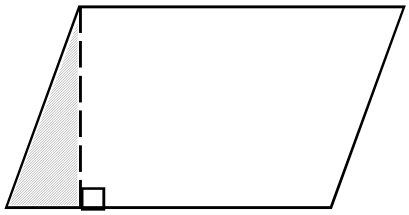


Figure 2

- Connect the snip out triangular part with the remaining part and make a rectangle as shown in Figure 3.

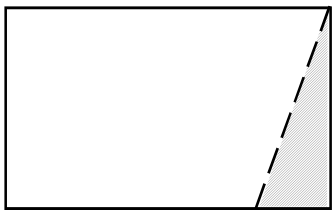
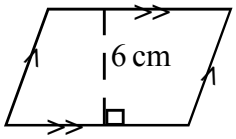


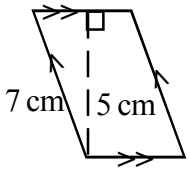
Figure 3

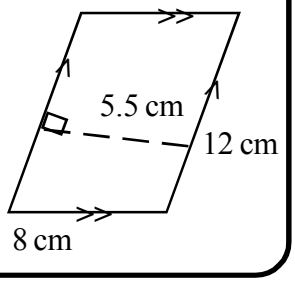
- Mark the length and breadth of that rectangle as *a* and *h* and write a formula for the area in terms of them.
- Take the other parallelogram cut at the beginning and derive a formula for it in terms of the area of the parallelogram.
- On the basis of them build up a formula for the area of a parallelogram *A* in terms of the length of a side *l* and the perpendicular distance between that side and the other equal side *b*.

Part B

- Using the formula you derived, find the area of each of the parallelograms given below..







Assessment and evaluation:

- Assessment criteria:
  - Reads and understands the instructions given and gets involved in the activity.
  - Derives a formula for the area of a parallelogram.
  - Finds the area of a given parallelogram.
  - Work cooperatively and efficiently with others.
  - Accepts that when a shape is cut and another shape is made, the area doesn't change.
- Direct the students to do the relevant exercises in lesson 23 of the textbook.

For your attention...

Development of the lesson:

- Design and implement an activities to find the area of a trapezium and a circle as appropriate.
- Get the students to drive formulae for their area and do exercises using them.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 23 of the textbook.

For further reference:

- http://www.youtube.com/watch?v=j3-XYLnxJDY
  http://www.youtube.com/watch?v=ZyOhRgnFmIY

24. Probability

Competency 31 : Analyzes the likelihood of an event occurring to predict future events.

Competency Level 31.1: Investigates the likelihood of an event by considering the outcomes of the experiment.

Number of Periods: 05

Introduction:

- Characteristics of a random experiment are as follows.
  - * Knowing all the results before doing the experiment.
  - * Not knowing the result obtained at a particular instance.
  - * Repeatability of the experiment.
  - * lack of a pattern in the results though the experiment is repeated.

- The set that includes all the likely results of a random experiment is the sample space of that experiment. If the results of an experiment have an equal likelihood they are referred to as equally probable.
  Ex: ① In an experiment in which the side facing up is noted when a cubical fair dice whose sides are marked with 1 - 6 is tossed, the results obtained are equally probable.
  Ex: ② In an experiment in which the colour of the side facing up when a dice whose 4 sides are painted white and 2 sides are painted black is tossed, the result obtained are not equally probable.

- If A is an event in the sample space S with equally likely out comes and p(A) is the probability of happening A, $p(A) = \frac{n(A)}{n(S)}$. Here, n(A) is the number of elements in the set of A while n(S) is the number of elements in the sample space.

  In this section, the subject concepts related to the probability described above are studied.

Learning outcomes relevant to Competency Level 31.1:

1. Identifies random experiments.
2. Identifies the set of all possible outcomes of an experiment as the sample space of that experiment.
3. Writes down the sample space of a given experiment.
4. Identifies equally likely outcomes.
5. Writes down examples of equally likely outcomes.

6. Performs calculations using the formula $P(A) = \frac{n(A)}{n(S)}$ for an event A of a random experiment with equally likely outcomes, having a sample space S.
7. Makes decisions in day to day life using the knowledge gained on probability.

Glossary of terms:

Random experiments	-	අහඹු පරීක්ෂණ	-	எழுமாற்றுப் பரிசோதனை
Sample space	-	නියැදි අවකාශය	-	மாதிரி வெளி
Equally Likely events	-	සමසේ භව්‍ය ප්‍රතිඵල	-	சமமாய் நிகழத்தக்க
Event	-	සිද්ධිය	-	நிகழ்ச்சி
Out come	-	ප්‍රතිඵලය	-	நுனநவெ

Instructions to plan the lesson:

A specimen lesson designed to develop in students the subject concept related to learning outcomes 2 and 3 adopting lecture discussion method after the subject concepts relevant to the first learning outcome under the competency level 31.1 are reinforced in students is given below.

Time: 40 minutes

Quality inputs:

- Copies of the evaluation sheet prepared to distribute to students at the end of the lesson for reinforcing the facts learnt. (one for each student)

Instructions for the teacher:

Approach:

- Initiate a discussion recalling the characteristics of a probability experiment learnt before and giving examples for such experiments.

Development of the lesson:

- Discuss with students and consolidate in them that an implement of tossing an unbiased coin is a probability experiment.
- Ask students which side of the coin faces up when the coin is tossed before tossing it and record all the results.
- Show that the experiment of tossing a cubical fair dice with numbers 1 - 6 is a probability experiment.
- Discuss all the probable results regarding the side facing up when tossing a dice and write the set that includes all the results on the board.

- Explain that the set that includes all the results in the above example is the sample space of those experiments.
- Discuss about the sample space of some other experiments also.
- Explain that sample space is symbolised by S.
- Distribute the question sheet to students, Let the students answer it and discuss about the answers given by students.

Assessment and evaluation:

- Assessment criteria:
  - Identifies all the likely results in a random experiment.
  - States that all the results in a random experiment is its sample space.
  - Writes the sample space of a given random experiment.
  - Completes the task within the given period of time.
- Direct the students to do the relevant exercises in lesson 24 of the textbook.

Activity sheet with questions for reinforcement:

- Write the sample space relevant to each of the following random experiments.

(1) Recording the number on the side facing down when a tetrahedral dice whose sides have numbers 1 - 4 is tossed.
Sample space, S = { }

(2) Recording the colour on the side facing up when a cubical dice with sides painted in red, blue, white, black, yellow and green is tossed.
Sample space s = { }

(3) Taking out a bead randomly from a bag containing three beads of colours red, blue and white.
Sample space, S = { }

(4) Taking out a marked piece of paper from a bag containing rolled pieces of paper numbered from 1 - 10.
Sample space, S = { }

(5) Taking out a ball randomly from a bag containing 4 identical balls of which 2 are red and numbered 1 and 2 while 2 are blue and numbered 1 and 2.
Sample space, S = { }

For your attention...

Development of the lesson:

- Plan suitable methods for learning outcomes 4, 5, 6 and 7 under the competency level 31.1 and implement with students.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 24 of the textbook.

For further reference:

- http://www.youtube.com/watch?v=mLE-SlOZToc
- https://www.youtube.com/watch?v=sPQM-yZgGwc

25. Angles of Polygons

Competency 23 : Makes decisions regarding day to day activities based on geometrical concepts related to rectilinear plane figures.

Competency Level 23.4: Performs calculations using the sums of the interior and exterior angles of a polygon.

Number of Periods: 05

Introduction:

A polygon is a closed plane figure bounded by segments of straight lines. The polygon in which each of the interior angle is less than 180^0 are called convex polygon whereas the polygons in which at least one interior angle is greater than 180^0 are known as concave polygons. The polygons in which all the sides and angles are equal are known as regular polygons. A polygon only with equal sides is an equilateral polygons.

The polygon with minimum number of sides is the triangle. In regular polygons there are axes of symmetry equal in number to the number of sides. In a regular polygon, the order of rotational symmetry is also equal to the number of sides.

From the distant past many polygonal shapes have been used in various creative works. Shapes of polygons takes a very important place in ancient architecture. Polygonal shapes are used to create tessellations. Polygonal shapes are seen even in natural creations such as the bee hives, spider webs and cells.

Under this section it is expected to give an understanding about the sum of the interior and exterior angles of a n-sided polygon in relation to competency level 23.4 . Accordingly it is expected to identify and verify the theorem ' The sum of all the interior angles of a n-sided polygon is equal to (2n-4) right angles' and solve simple geometry problems using it. It is also expected to identify and verify the theorem' the sum of all the exterior angles of n-sided polygon is equal to 4 right angles' and solve simple geometry problems using it.

Learning outcomes relevant to Competency Level 23.4:

1. Identifies the theorem, "The sum of the interior angles of an n-sided polygon equals $(2n-4)$ right angles".
2. Verifies the theorem, "The sum of the interior angles of an n-sided polygon equals $(2n-4)$ right angles".
3. Solves simple geometric problems using the theorem, "The sum of the interior angles of an n-sided polygon equals $(2n-4)$ right angles".

4. Identifies the theorem, "The sum of the exterior angles of an *n*-sided polygon is four right angles".
5. Verifies the theorem, "The sum of the exterior angles of an *n*-sided polygon is four right angles".
6. Solves simple geometric problems using the theorem, "The sum of the exterior angles of an *n*-sided polygon is four right angles".

Glossary of terms:

Rectilinear closed plane figures	- සරල රේඛීය සංවෘත තල රූප	- எண்கோலம்
Triangle	- ත්‍රිකෝණය	- பொது உறுப்பு
Quadrilateral	- චතුරස්‍රය	- மடங்குகள்
Pentagon	- පංචාස්‍රය	- எண்ணும் எண்கள்
Hexagon	- ෂඩස්‍රය	- இரட்டை எண்கள்
Interior angle	- අභ්‍යන්තර කෝණය	- ஒற்றை எண்கள்
Exterior angle	- බාහිර කෝණය	- சதுர எண்கள்
Regular polygons	- සවිධි බහුඅස්‍ර	- முக்கோணி எண்கள்

Instructions to plan the lesson:

Given below is a group activity and guide inquiry method -based specimen lesson design to develop in students the subject concepts related to the learning outcomes 1 and 2 under the competency level 23.4 .

Time: 40 minutes

Quality inputs:

- Copies of the activity sheet

Instructions for the teacher:

Approach:

- Start a discussion on the polygon with students drawing their attention to the following facts.
  - convex and concave polygons
  - naming polygons from triangle to decagon
  - instances where polygons are used for creative work
- Inquiring into the interior angles of polygon recall that the sum of the interior angles of a triangles is 180^0 and the sum of the interior angles of a quadrilateral is 360^0.

Development of the lesson:

- Divide the class into groups as appropriate and distribute copies of the activity sheet one to each group.
- Show how one vertex is joined to the other in the polygons triangle, quadrilateral, pentagon etc.
- Engage every student in the activity.
- At the end of the activity come to the generalization that the sum of the interior angles of a polygon is (2n - 4) right angles.

Activity sheet for the students:

In each polygon in the table, join on vertex with the other vertices by a straight line.

Write the number of triangles obtained when one vertex is joined with the others.

- Build up a relationship between the number of sides of each polygon and the number of triangles.
- Derive a relationship to find the sum of the interior angles of the polygon using the sum of the interior angles of a triangle.
- Taking the sum of the interior angles of a triangle as two right angles, write the sum of the interior angles of the polygon in terms of right angles.

Polygon	Diagram	No. of sides	No. of triangles obtained by joining one vertex with others.	No. of triangles obtained - No. of sides of the polygon	Sum of the interior angles	
					As a multiple of the interior angles of a triangle	In terms of the number of triangles and sides
Triangle		3	1	3-2	$180^0 \times 1$	$2\times(3-2)$
Quadrilateral		4	2	4-2	$180^0 \times 2$	$2\times(4-2)$
Pentagon						
Hexagon						
Heptagon						
Octagon						
Polygon with n sides						

Assessment and evaluation:

- Assessment criteria:
  - Joins the straight lines a vertex of a polygon with the others.
  - Computes correctly the number of triangles obtained by joining one vertex with other vertices.
  - Finds a relationship between the number of sides of a polygon and the number of triangles.
  - Accepts that the sum of the interior angles of any polygon can be calculated using the sum of the interior angles of the triangles.
- Direct the students to do the relevant exercises in lesson 25 of the textbook.

For your attention...

Development of the lesson:

- Let the students solve geometric problems containing simple calculations to achieve the learning outcomes 3 and 6 relating to the competency level 23.4. Design and implement a suitable activity for learning outcomes 4 and 5.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 25 of the textbook.

For further reference:

-

26. Algebraic Fractions

Competency 16 : Explores the various methods of simplifying algebraic fractions to solve problems encountered in day to day life.

Competency Level 16.1: Analyses relationships in daily life by simplifying algebraic fractions.

Number of Periods: 03

Introduction:

Either denominator or numerator or both denominator or numerator is/are algebraic terms or algebraic expressions are called algebraic fractions.

$$\frac{1}{x}, \frac{1}{2a}, \frac{x}{5}, \frac{y}{2}, \frac{2a}{3b}, \frac{1}{x+1}, \frac{2}{2a+b}, \frac{x+3}{x+2}$$

As in the case of common fractions, in the addition and subtraction of algebraic fractions, the denominators should be made equal.

Learning outcomes relevant to Competency Level 16.1:

1. Identifies algebraic fractions.
2 Adds and subtracts algebraic fractions with equal integral denominators.
3 Adds and subtracts algebraic fractions with unequal integral denominators.
4. Adds and subtracts algebraic fractions with equal algebraic denominators.

Glossary of terms:

වීජීය භාග	- எண்கோலம்	- Algebraic fractions
හරය	- பொது உறுப்பு	- Denominator
ලවය	- மடங்குகள்	- Numerator
පොදු හරය	- எண்ணும் எண்கள்	- Common Denominator
කුඩා ම පොදු ගුණාකාරය	- இரட்டை எண்கள்	- Least common multiple
තුල්‍ය භාග	- ஒற்றை எண்கள்	- Equivalent fractions

Instructions to plan the lesson:

A specimen lesson with a group activity for developing in students the subject concepts related to the learning outcomes 3 under the competency level 16.1 is given below.

Time: 40 minutes

Quality inputs:

- Copies of the activity sheet
- Cards containing the following algebraic fractions

$\frac{x}{3}$	$\frac{x}{4}$	
$\frac{x+2}{5}$	$\frac{y}{3}$	
$\frac{y+3}{4}$	$\frac{y}{5}$	
$\frac{x-1}{2}$		

$\frac{a}{2}$	$\frac{a+3}{5}$	
$\frac{b}{3}$	$\frac{b}{4}$	
$\frac{b-1}{2}$		
$\frac{a+1}{3}$		

$\frac{m}{3}$	$\frac{n}{6}$	
$\frac{m+1}{4}$		
$\frac{n+2}{2}$		
$\frac{n}{4}$	$\frac{m}{2}$	

Instructions for the teacher:

Approach:

- Discuss with students about the addition and subtraction of numerical fractions with equal and unequal denominators.
- Also discuss about the simplification of algebraic fractions carrying like terms and unlike terms.
- Discuss with students about the simplification of two algebraic fractions with equal denominators such as $\frac{5x}{3}+\frac{x}{3}$ .Emphasize that here too, the method used in the simplification of numerical fraction is followed.

Development of the lesson:

- Divide the class into six groups as appropriate
- Distribute a copy of the activity sheet and a card with algebraic fractions to each group and engage the students in the activity.
- Go to each group and give necessary support.
- After completion of the task, discuss step by step by asking questions how two algebraic fractions with unequal numerical denominators are added.
- Discuss with students and emphasize that when adding fractions with unequal numerical denominator, first the least common multiple of those two numbers should be found.
- Stress that the answer can then be obtained by simplifying the numerator.

Activity sheet for the students:

- Pay attention to the card provided to your group.
- Of the algebraic fractions given in the card, select two algebraic fractions with unequal denominators.
- Find the least common multiple of the denominators of those fractions.
- According to the least common multiple, write fractions equivalent to each algebraic fraction.
- Recalling the addition of two fractions with equal denominators, add these two fractions and get the answer.
- If possible, simplify the answer further.
- Of the two fractions, subtract the smaller fraction from the larger fraction and obtain the answer.
- Select another pair of fractions with unequal denominators and add and subtract them as was done before.

Assessment and evaluation:

- Assessment criteria:
  - Identifies algebraic fractions.
  - Obtain common denominator of integral denominators by finding the least common multiple of the denominators of algebraic fractions with unequal integral denominators.
  - Accepts that the common denominator should be obtained when simplifying algebraic fractions with unequal integral denominators.
  - Obtains fractions equivalent to algebraic fractions according to the common denominator.
  - Adds and subtracts two algebraic fractions with unequal integral denominators.
  - Acts cooperatively within the group and reaches the target.
- Direct the students to do the relevant exercises in lesson 26 of the textbook.

For your attention...

Development of the lesson:

- Make students aware about the addition and subtraction of algebraic fractions with equal algebraic denominators.

Assessment and evaluation:

- Direct the students to do the relevant exercises in lesson 26 of the textbook.

For further reference:

-

27. Scale Diagrams

Competency 13 : Uses scale diagrams in practical situations by exploring various methods.

Competency Level 13.1: Indicates the direction of a location by means of an angle.

Competency Level 13.2: Investigates various locations in the environment using scale diagrams.

Number of Periods: 07

Introduction:

Students have learnt in previous grades how to describe the location of a place being at another position using directions. Bearing is used as a measure of location in relation to northern direction. Bearing is obtained by a clock-wise rotation from the direction of north identified using a compass. Indicating the angle of rotation by three digits is a convention. All the rotation should be on the same plane. This section focuses on deciding the location of a place by bearing and distance and solving problems related to it.

Learning outcomes relevant to Competency Level 13.1:

1. Explains "bearing".
2. Accepts that the bearing and the distance are needed to describe the location of a place with respect to another place on a horizontal plane.
3. Identifies the clinometer as an instrument that is used to measure bearing and uses it.
4. Describes various locations in terms of bearing and distance.
5. Performs calculations related to bearing.

Glossary of terms:

Distance	-	දුර	-	தூரம்
Location	-	පිහිටීම	-	அமைவு
Horizontal plane	-	තිරස්තලය	-	கிடைத்தளம
Bearing	-	දිගංශය	-	சைகோள்
Compass	-	මාලිමාව	-	திசையறிகருவி
Clock wise	-	දක්ෂිණාවර්ත	-	வலஞ்சுழி

Instructions to plan the lesson:

Given below is a specimen lesson with a practical activity designed to achieve learning outcome 4 with the aim of giving practical experience to students of locating a place after a developing in them the learning outcomes 1, 2 and 3 under the competency level 13.1.

Time: 80 minutes

Quality inputs:

- Protractors with the calibration 0 - 360^0 and fixed on thick 20 cm × 20 cm polystyrene sheets with a tube (annex 1) - one for each group
- Compasses- one for each group
- Measuring tapes (10 m/ 20 m)- one for each group
- Copies of the activity sheets

Instructions for the teacher:

Approach:

- Recalling that the direction north can be obtain in relation to east on which the sun rises or using a compass, draw a diagram to show the eight directions in the board.
- Explain that north is used as the base to describe the location of a place using the bearing.
- Let the students do the following activity to inquire into the method of finding the location by rotating the angle clockwise from north.

Development of the lesson:

- Divide the class into groups of five.
- Let each group go out carrying a desk with a flat top. (If it is difficult to do the activity outdoor, select suitable places inside the classroom.)
- Give each group an activity sheet , a compass, a protractor and measuring tape.
- Assign a place for each group and instruct to align 0^0 in the protractor on the table along the direction of north identified by the compass.
- Assign four points A, B, C and D for the students to observe. (Position one of these along one of the other three main directions.)
- Ask students to observe the place marked and to measure and record the relevant angle and the distance to the place from the point from which the measurement is made.
- After the completion of the activity make a review in the light of the sketches made by groups to highlight that the location of a place can be indicated by the angle measured clockwise from the north and the distance.

Activity sheet for the students:

Keep the desk at the place assigned to you, keep the compass on it and identify north. Place the protractor steadily on the desk so that its 00 points north.

- Observe each place shown to you by the teacher through the drinking straw fixed to the protractor. Measure clockwise from north the angle corresponding to the location of each place and record it.
- Measure the distance from the protractor to the place you were asked to observe by the teacher with the measuring tape and record as follows.

  P ⇨ 040^0 → 12m

  (This means that P is located at an angle of 40^0 clockwise from north at a distance of 12 m)
- Indicate the measurements made in a table such as the one shown below.

Observation point (place)	Angle	Distance (m)
A B C D		

- Present the above information on a rough chart.
- Present your work to the whole class.

Assessment and evaluation:

- Assessment criteria:
  - Measures correctly clockwise from the north the angle along which a given point is located from another given point.
  - Accepts that in order to locate a place distance is also essential in addition to the bearing.
  - Measures correctly the distance from a given point to another given point.
  - Indicate in a rough sketch the location of a place relative to another place using angle and distance.
  - Accepts the convenience of working as a group.
- Direct the students to do the relevant exercises in lesson 27 of the textbook.

Practical applications:

- This section is very important for giving the location of a certain point definitely and to take measurements required to sketch a plan of a small plot.

For further reference:

28. Data Representation and Interpretation

Competency 28 : Facilitates daily work by investigating the various methods of representing data.

Competency 29 : Makes predictions after analyzing data by various methods, to facilitate daily activities.

Competency Level 28.1: Represents data such that comparison is facilitated.

Competency Level 29.1: Investigates frequency distributions using representative values

Number of Periods: 10

Introduction:

A given group of data can represent in a frequency distribution without class interval and interpret. Such a distribution is known as an ungrouped frequency distribution. When there is a large amount of data with regard to an experiment use of ungrouped frequency is not an easy or meaningful task. In such a case we can make the task manageable by taking data as groups and indicating the frequency rather than giving the frequency for each piece of data. Such a table in which frequencies are given for grouped sets of data is known as a grouped frequency distribution. Generally a grouped frequency distribution has two columns. One is the groups of the data known as class intervals and the other is the number of the pieces of data within those class intervals or frequency. This aims to study how a given group of data is represented in a frequency distribution with class intervals.

Learning outcomes relevant to Competency Level 28.1:

1. Identifies a frequency distribution.
2. Presents a given group of data in a frequency distribution without class intervals.
3. Identifies what a class interval is.
4. Identifies presenting data in class intervals as grouping data.
5. Represents a given group of data in a frequency distribution with class intervals.

Glossary of terms:

Data	-	දත්ත	-	தரவு
Frequency distribution	-	සංඛ්‍යාත ව්‍යාප්තිය	-	மீடிறன் பரம்பல்
Grouping	-	සමූහනය	-	கூட்டமாக்கல்
Class intervals	-	පන්ති ප්‍රාන්තර	-	வகுப்பாயிடைகள

Instructions to plan the lesson:

This lesson aims to develop the subject concepts relating to the learning outcomes 5 after the reinforcement of subject concepts relating to the learning outcomes 1, 2, 3 and 4 in students under the competency level 28.1. A specimen lesson designed for this adopting the lecture discussion method coupled with an individual activity is presented below.

Time: **40 minutes**

Quality inputs:

- Copies of the activity sheet
- A slot panel
- A flip chart with the grouped frequency table
- Cards with data
- Felt pens
- A_4 sheets

Instructions for the teacher:

Approach:

- Start a discussion asking how a given group of data is represented in a frequency distribution without class intervals.
- Discuss about the class interval and the way the data are grouped.
- Approach the lesson asking how a grouped frequency table is prepared by grouping data when the amount of data is large.

Development of the lesson:

- Say that when preparing a grouped frequency distribution, first the **range** of data should be found.
- Describe that **range** means the difference between the highest and lowest values of given data.
- Say that afterwards, separation into suitable class intervals can be done in two ways. One is, first deciding on the number of class intervals and then the class size accordingly. The other is first deciding on the class size and then finding the number of class intervals.
- Explain that when finding the class size, the range should be divided by the number of classes while when finding the number of class intervals the range should be divided by the class size. Say that here the answer should be obtained to the nearest whole number.

- Describe that after separation of class intervals, the grouped frequency distribution is prepares by tallying all the data and writing the respective numbers opposite each class interval
- Then group the students as appropriate and distribute a copy of the activity sheet and a paper to each.
- Engage the students in the activity.
- Let the students present their findings.
- Following the presentation of findings remove the data presented in the slot panel and fill the grouped frequency table drawn in the flop chart. Build up the whole of the lesson.

Activity sheet for the students:

- Engage individually in the activity according to the instruction given to you. Given below is the information regarding the s.m.s. received by an amateur singer at a reality show to make him the winner.

5	21	12	32	45	32
23	6	24	18	40	35
26	13	15	7	38	49
24	13	24	19	35	28
27	38	28	25	40	15

(i) What is the minimum value in this group of data?
(ii) What is the maximum value in this group of data?
(iii) Taking the number of class interval as 5, find the width of a class by dividing the range of the group of data by 5.
(iv) Using that class width, prepare the relevant class intervals starting with the minimum value in the group of data.
(v) Prepare a grouped frequency distribution using tally marks and inserting data relevant to each interval.
(vi) Get ready to present the frequency distribution prepared.

Assessment and evaluation:

- Assessment criteria:
  - Describes how the range of a group of data is found.
  - Decides the number of class intervals, finds the class width and prepares class intervals.
  - Groups the data and prepares a frequency distribution.

- Accepts that it is easy to retrieve data by grouping data when the amount of data is large.
- Works in the group respecting the ideas of the others.

- Direct the students to do the relevant exercises in lesson 28 of the textbook.

For your attention...

Development of the lesson:

- Plan and implement a suitable method to develop in students the subject concepts related to the learning outcomes in the competency level 29.1

For further reference:

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