Mathematics

Teacher's Guide

Grade 11

Department of Mathematics
Faculty of Science and Technology
National Institute of Education
Sri Lanka
www.nie.lk

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The Message of the Director General

This Manual provides the teacher with the essentials required to implement the subject curriculum in their respective school. In implementing the curriculum, teachers must always bear in mind that their work will have paramount and far-reaching consequences for the child's cognitive achievement and behavioural development.

On the dimension of cognitive achievement, teachers must pay attention, inter alia, to the following where learning quality is higher:

- When the learner is aware of his/her life goals and the task is both relevant to goal achieve ment as well as abilities;
- When the learner is involved actively in the process of teaching/learning (student-centered process). Recall what Confucius said: What they hear, they forget; What they see, they remember; & What they do, they learn.
- When the learning environment is conducive, i.e. resourceful and challenging. Ensure access to study materials, equipment, labs, cases and experiences from multiple sources; and
- When the learner is given prompt feedback, both positive and constructive. In doing so, enable the learning to occur sequentially with higher levels of absorption, and integration with existing knowledge, skills and goals of the learner.

In education, expectation of the government is to enable all children in schools to reach the required levels of mastery of fundamentals of the subject matter, so that they experience the joy of achievement after facing examinations.

In the dimension of behavioural development of the child, the objective of education is to link cognitive achievement with the world of work. Therefore, curriculum delivery in the hand of teacher must foster the competencies that the learner requires to possess in dealing with the world outside the school. Some of the important, generic competencies are in these areas:

- Industrious work ethic - Positive attitudes, will to innovate, and persevere;
- Interpersonal relations - Teamwork, discipline, and effective communication;
- Moral values - A person with integrity possessing civic values such as respect for diversity

In conclusion, I wish to ask all principals, teachers and other staff in schools to look at the process of teaching and learning with attention to 4AS in management: Attitude, Analysis, Action, & Accountability. Start with the relevant and positive attitudes about the ends and means of what you do (your lesson, etc.); search, obtain and analyse information in order to organize (session plans etc.); consider options and take prompt action efficiently (deliver); and monitor, assess and measure results to take accountability (ownership).

I take this opportunity to wish all the teachers involved the joy of teaching and learning. Please do not hesitate to write to the relevant Head of Department at NIE, with copy to me where desirable, on your experiences and observations of this Manual.

Prof. Gunapala Nanayakkara, PhD (Carleton)
Director General

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
Deputy Director General
Faculty of Science and Technology

Foreword

Teachers are leading personalities among those who render a great service for the progression of the society. Teachers guide the children to mould their characters.

The Educational Publications Department takes measures to print and publish these Teacher Instructional Manuals to facilitate the teachers to cary out the teaching process successfully in accordance with the new syllabi to be implemented with effect from 2015. I strongly believe that this Teacher Instructional Manual compiled by the National Institute of Education will provide the required guidance to create a favourable learning environment for the children to learn.

This venture will achieve its success on the effort made to utilize the experience acquired by using this Teacher Instructional Manual in the teaching learning process. I bestow my gratitude on all those who dedicated themselves for this national endeavour.

Tissa Hewavithana
Commissioner General of Educational Publications
Educational Publications Department,
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Battaramulla.
22.09.2015

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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 11 Mathematics Teacher's Guide which has been prepared accordingly has many special features.

The **Grade 11 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

Contents

Syllabus

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.

1.4 Subject Content

Competency	Competency Level	Content	Learning Outcomes	Periods
Numbers **Competency – 1** Manipulates the mathematical operations in the set of real numbers to fulfill the needs of day to day life.	**1.1** Analyses the set of rational numbers.	• Identifying rational numbers • Terminating decimals • Recurring decimals	• Distinguishes fractions which are terminating decimals from those which are recurring decimals by simplifying given fractions. • Selects fractions which are terminating decimals and those which are recurring decimals by examining the denominator. • Accepts that fractions of the form $\frac{p}{q}$ where p and q are integers with $q \neq 0$, are either terminating decimals or recurring decimals. • States that fractions of the form $\frac{p}{q}$ where p and q are integers with $q \neq 0$ are rational numbers (Q). Provides reasons as to why integers are also rational numbers.	**03**
	1.2 Analyses the set of real numbers.	• Identifying irrational numbers • Expressing the set of natural numbers, the set of integers, the set of rational numbers, the set of irrational numbers and the set of real numbers using set notations	• States that the square root of a number which is not a perfect square is neither a terminating decimal nor a recurring decimal. • Identifies infinite decimals which are not recurring decimals as irrational numbers. • Distinguishes a given set of numbers as rational numbers and irrational numbers.	**03**

			• Names the set of numbers that can be represented on a number line as the set of real numbers. • Identifies the symbols that are used to denote the set of natural numbers, the set of integers, the set of rational numbers, the set of irrational numbers and the set of real numbers. • Represents the set of natural numbers, the set of integers, the set of rational numbers, the set of irrational numbers and the set of real numbers using set notations. • Accepts that the set of natural numbers (N), the set of integers (Z), the set of rational numbers (Q) and the set of irrational numbers (Q') are subsets of the set of real numbers (R). • Represents the set of natural numbers, the set of integers, the set of rational numbers, the set of irrational numbers and the set of real numbers in a Venn diagram.	

	1.3
	Manipulates the basic mathematical operations in relation to surds.
		• Identifying surds as irrational numbers
		• Writing entire surds as surds
		• Surds
		  • Addition
		  • Subtraction
		  • Multiplication
		  • Division
			• Identifies surds as irrational numbers.
			• Identifies entire surds.
			• Writes an entire surd as the product of a rational number and an irrational number.
			• Writes a number which is written as a product of a rational number and an irrational number as
				04

		• Simplifying the denominator as the rational (the form $\frac{a}{\sqrt{b}}$ only)	an entire surd. • Simplifies expressions of surds containing up to three terms and involving the basic mathematical operations. • Rationalizes the denominator of an expression of the form $\frac{a}{\sqrt{b}}$ where a and b are positive integers. • Explores easy methods of finding the value of a quotient that has a surd as the denominator.	
Competency – 2 Makes decisions for future requirements by investigating the various relationships between numbers.	**2.1** Investigates the various behavioral patterns of number sequences which are progressions.	• Geometric progressions • Introduction • n^{th} term • Sum of the first n terms	• Identifies number sequences of which the quotient between a term and the preceding term is a constant, as **geometric progressions.** • Selects the geometric progressions from among a set of number sequences. • Determines the common ratio (r) of a geometric progression. • Develops the formula $T_n = ar^{n-1}$ for the n^{th} term of a geometric progression with first term (a) and common ratio (r). • For a geometric progression, finds the value of the fourth unknown term using the formula, when the values of three of the four unknowns a, r, n and T_n are given. • Finds the values of a and r using simultaneous equations when two terms of a geometric	**06**

			progression are given. • States that there are two progressions satisfying the given conditions, when two values are obtained for r when solving problems related to geometric progressions. • Develops the formulae $s_n = \frac{a(r^n-1)}{r-1}$ if $\|r\| > 1$ and $s_n = \frac{a(1-r^n)}{1-r}$ if $\|r\| < 1$, for the sum of the first n terms of a geometric progression with first term a and common ratio r. • Finds the sum of the first few terms of a geometric progression by selecting the relevant formula according to the value of $\|r\|$. (For $S_n < 20000$ only). • For a geometric progression, finds the fourth value using the formula, when the values of three of the four unknowns a, r, n and S_n are given (For $S_n < 20000$ only). • Solves problems related to geometric progressions. (For $S_n < 20000$ only)	
Competency - 5 Uses percentages to make successful transactions in the modern world.	**5.1** Uses percentages when making transactions in installments.	• Percentages • Interest on the reducing balance • Loan installments	• Gives examples of situation where payments are made in installments. • Calculates the interest considering the monthly amount based on the reducing balance. • If the number of installments for a loan amount is n, calculates the number of month units for which the interest needs to be paid, by using the formula $\frac{n(n+1)}{2}$.	**03**

			• Calculates the interest considering the number of installments based on the reducing balance. • Calculates the total amount that should be paid to be free of the loan. • Calculates the value of an equal monthly installment by considering the total amount that needs to be paid. • Finds the interest rate charged for the loan amount when the value of an equal monthly installment is given. • Analyses practical situations where the reducing balance is used (apart from loans).	
	5.2 Makes transactions by comparing interest schemes.	• Compound Interest • Compound interest (Up to three terms)	• Identifies the method of calculating compound interest. • Performs calculations related to compound interest up to three terms. • Compares the compound interest scheme with the simple interest scheme.	**03**
	5.3 Considers the share market in order to make investments.	• Limited Companies • Shares	• Accepts that many people can be involved in a business through the investment in shares. • Accepts that limited companies supply their capital by issuing shares. • Names the price of a share of an established company as the **Market price of a share**. • States that the **Value of shares** (invested funds) is obtained by multiplying the market price of a share by the number of shares. • States that the number of shares that can be bought is obtained by dividing the invested	**05**

			funds (value of shares) by the market price of a share. • Calculates the **dividend income** that an investor receives by multiplying the dividend paid for a share by the number of shares. • Solves problems involving invested funds (value of shares), market price of a share, capital profit and dividend paid for a share.	
Competency – 6 Uses logarithms and calculators to easily solve problems in day to day life.	**6.1** Solves equations containing powers with rational indices.	• Indices • Simplifying expressions involving powers with rational indices • Solving equations of powers with rational indices	• Writes a number expressed in the form $\sqrt[n]{a}$ in index form as $\frac{1}{an}$. • Simplifies expressions involving powers with rational indices. • States that if the bases of two equal powers are equal, then their indices are also equal. • States that if the indices of two equal powers are equal, then their bases are also equal. • Solves equations involving powers with rational indices.	**04**
	6.2 Solves equations involving logarithms.	• Laws of logarithms (Related to powers and roots) • Simplifying expressions involving powers and roots by applying the laws of logarithms	• Identifies the law of logarithms $\log_a m^r = r \log_a m$. • Verifies the law $\log_a m^r = r \log_a m$ when r is rational by substituting numerical values for r and m. • Simplifies expressions involving powers and	**04**

		• Solving equations involving powers and roots by applying the laws of logarithms.	roots by applying the laws of logarithms. • Solves equations involving powers and roots by applying the laws of logarithms.	
	6.3 Facilitates simplifications by using logarithms.	• Using the logarithms table • Logarithm of numbers between 0 and 1. • Expressions involving numbers between 0 and 1 (Including powers and roots) • Multiplication • Division • Simplifying expressions involving decimals, powers and roots.	• Writes the characteristic of the logarithm of a number between 0 and 1. • Adds logarithms with negative characteristics. • Subtracts logarithms with negative characteristics. • Multiplies a logarithm with a negative characteristic by a whole number. • Divides a logarithm with a negative characteristic by a whole number. • Using the logarithms table, simplifies expressions of the form a^m where a is a decimal number and m is a whole number. • Using the logarithms table, simplifies expressions of the form $\sqrt[m]{a}$ where a is a positive decimal number and m is a whole number. • Using the logarithms table, simplifies expressions of the form $\frac{a^m x\sqrt[n]{b}}{c}$ and $\frac{a^m xb}{\sqrt[n]{c}}$ where a, b and c are positive decimal numbers and m and n are whole numbers. • Uses the logarithms table to facilitate simplifications when solving other mathematical problems.	**04**

	6.4 Uses the scientific calculator to solve mathematical problems including problems involving trigonometric ratios.	• Scientific Calculator • Using the scientific calculator • The keys $\sqrt{\ }$ and $\wedge$ • Simplifying expressions involving decimals, powers and roots • The keys sin , cos , tan • The keys $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$	• Uses the keys x , $\wedge$, n and = in the given order to obtain the value of x^n when x and n are whole numbers. • Uses the keys , , , and in the given order to obtain the value of $\sqrt[n]{a}$ when a and n are whole numbers. • Using the calculator, simplifies expressions involving multiplications and divisions and including terms of the form x^n and $\sqrt[n]{a}$. • Uses the keys sin , θ and = in the given order, to obtain the sine value of the angle θ. • Uses the keys cos , θ and = in the given order, to obtain the cosine value of the angle θ. • Uses the keys tan , θ and = in the given order, to obtain the tangent value of the angle θ. • When the sine value x of the angle θ is given, uses the keys shift , sin , x and = in the given order, to obtain the value of the angle θ. • When the cosine value x of the angle θ is given, uses the keys shift , cos , x and = in the given order, to obtain the value of the angle θ. • When the tangent value x of the angle θ is given, uses the key shift , tan , x and = in the given order, to obtain the value of the angle θ.	**02**

Measurements **Competency – 8** Makes use of a limited space in an optimal manner by investigating the area.	**8.1** Investigates the surface area of various solid objects in the environment.	• Area • Surface area of a square based right pyramid. • Surface area of a right circular cone • Surface area of a sphere	• States that a square based right pyramid has four triangular faces apart from the square base. • Shows that the surface area A of a square based right pyramid with side length of the base equal to a and perpendicular height of a triangular face equal to h is given by $A = a^2 + 2ah$. • Calculates the surface area of a square based right pyramid using the given data. • Calculates the perpendicular height of a triangular face when the length of a side of the square base and the altitude of the pyramid are given. • Solves problems related to the surface area of square based right pyramids. • States that a right circular cone is a solid object consisting of a curved surface and a flat circular base. • States that for a right circular cone, the straight line passing through the apex of the cone and the centre of the circular base is perpendicular to the base. • Accepts that the radius of the sector that forms the cone is equal to the slant height of the cone.	**05**

			• Accepts that the arc length of the sector that forms the cone is equal to the circumference of the base of the right circular cone. • States that the surface area of the curved surface of a right circular cone of base radius r and slant height l is πrl. • Shows that if the total surface area of a right circular cone of base radius r and slant height l is A then $A = \pi r^2 + \pi rl$. • Calculates the surface area of a right circular cone using the given data. • Calculates the surface area when the perpendicular height and the base radius of a right circular cone are given. • Solves problems related to the surface area of a right circular cone. • Recognizes that for a sphere of radius r, the surface area A is given by $A = 4\pi r^2$. • Calculates the surface area of a sphere when its radius r is given. • Calculates the radius of a sphere when its surface area is given. • Solves problems related to the surface area of a sphere.	

Competency – 10 Gets the maximum out of space by working critically with respect to volume.	**10.1** Explores the volume of various solid objects.	• Volume • Right cone • Sphere • Right pyramid with a square base	• States that for a right circular cone, if the base radius is r, the perpendicular height is h and the volume is v, then $v = \frac{1}{2}\pi r^2 h$ • Calculates the volume of a cone using the given data. • Explains the change that occurs in the volume of a right cone when its radius r and its height h vary. • Solves problems related to the volume of a cone. • Discovers that the volume of the circumscribed cylinder of radius r and height $2r$ can be obtained from the sum of the volume of the sphere of radius r and the volume of a right cone of height $2r$ and base radius r. • Develops the formula $v = \frac{4}{2}\pi r^2$ for the volume v of a sphere of radius r. • Calculates the volume of a sphere using the given data. • Solves problems related to the volume of a sphere. • Discovers that the volume of a pyramid of perpendicular height h and square base of side length a is $\frac{1}{2}$ the volume of a square based	**05**

			cuboid of height h and side length of the base a. • Develops the formula $v = \frac{1}{3}a^2h$ for the volume v of a pyramid of perpendicular height h with a square base of side length a. • Calculates the volume of a square based pyramid using the given data. • Solves problems related to the volume of square based pyramids.	
Competency – 13 Uses scale diagrams in practical situations by exploring various methods.	**13.1** Identifies the trigonometric ratios of a right angled triangle.	• Trigonometric ratios • Sine • Cosine • Tangent	• Discovers that the sine value of an angle in a right angled triangle is given by the ratio of the length of the opposite side to the length of the hypotenuse. • Discovers that the cosine value of an angle in a right angled triangle is given by the ratio of the length of the adjacent side to the length of the hypotenuse. • Discovers that the tangent value of an angle in a right angled triangle is given by the ratio of the length of the opposite side to the length of the adjacent side.	**02**
	13.2 Manipulates trigonometric relationships to fulfill daily requirements.	• Problems related to trigonometric ratios (30°, 45°, 60° and including angles of	• Performs calculations related to trigonometric ratios. • Solves problems related to trigonometric ratios.	**10**

		elevation and depression) • Using trigonometric tables (To find distances, heights and the magnitudes of angles/ including angles of elevation and depression and bearings , involving only one variable and in only one plane) • Solving trigonometric problems using a scientific calculator	• Calculates the lengths of the sides and the magnitudes of the angles of right angled triangles using the trigonometric tables. • Solves problems involving angles of elevation and depression using trigonometric ratios. • Solves problems involving bearings using trigonometric ratios. • Uses a scientific calculator to examine the solutions to trigonometric problems.	
Algebra **Competency – 14** Simplifies algebraic expressions by systematically exploring various methods.	**14.1** Determines the cubes of binomial expressions.	• Expanding binomial expressions • Cube • Of the form $(x \pm y)^3$ • Of the form $(x \pm 5)^3$	• Recognizes $x^3 + 3x^2y + 3xy^2 + y^3$ as the expansion of $(x + y)^3$. • Expands cubes of binomial expressions of the form $(x + 5)^3$. • Recognizes $x^3 - 3x^2y + 3xy^2 - y^3$ as the expansion of $(x - y)^3$. • Accepts that the expansion of $(x - y)^3$ can be obtained by substituting (-y) for y in the expansion of $(x + y)^3$. • Expands cubes of binomial expressions of the form $(x - 5)^3$.	**04**

Competency - 16 Explores the various methods of simplifying algebraic fractions to solve problems encountered in day to day life.	**16.1** Manipulates algebraic fractions under the operations of multiplication and division.	• Algebraic fractions • Multiplication • Division	• Multiplies algebraic fractions with algebraic terms in the numerator or in the denominator or in both the numerator and the denominator. • Multiplies algebraic fractions with algebraic expressions in the numerator or in the denominator or in both the numerator and the denominator. • Finds the reciprocal of an algebraic fraction. • Divides algebraic fractions with algebraic terms in the numerator or in the denominator or in both the numerator and the denominator. • Divides algebraic fractions with algebraic expressions in the numerator or in the denominator or in both the numerator and the denominator. • Simplifies expressions of algebraic fractions.	**04**
Competency – 17 Manipulates the methods of solving equations to fulfill the needs of day to day life.	**17.1** Uses simultaneous equations to solve problems.	• Simultaneous equations (two unknowns with distinct rational coefficients) • Solving • Constructing	• Solves a pair of simultaneous equations in two unknowns with distinct rational coefficients by equating the coefficients of one unknown. • Solves a pair of simultaneous equations in two unknowns with distinct rational coefficients by making one unknown the subject of one of the equations and substituting it in the other equation. • Verifies with reasons, the accuracy of the	**05**

			solution to a pair of simultaneous equations by substituting the obtained values back into the pair of equations. • Expresses the relationships in the given information by a pair of simultaneous equations in two unknowns. • Solves the constructed pair of equations by either equating the coefficients of one unknown or by making one unknown the subject of one equation and substituting in the other.	

	17.2
	Investigates how quadratic equations can be used to solve problems that arise in daily life.
		• Quadratic equations
		• Solving
		  • Using factors
		  • By completing the square
		  • By using the formula
		• Constructing
			• Finds the solution to a quadratic equation by using the factors of the trinomial quadratic expression in the quadratic equation.
			• Solves a quadratic equation by completing the square.
			• Solves a quadratic equation by using the formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.
			• Verifies with reasons, the accuracy of the solution to a quadratic equation by substituting the obtained solution back into the equation.
			• Expresses the relationship in the given information by a quadratic equation.
			• Solves the constructed quadratic equation by using factors, by completing the square or by using the formula.
				05

Competency – 18 Analyzes the relationships between various quantities related to real-life problems.	**18.1** Solves problems that involve the relationships between two quantities.	• Inequalities • Solving and representing the solutions on a number line • Of the form $ax+b \lessgtr cx+d$ • Solving problems related to inequalities	• Finds integral solution sets of the inequalities $ax + b > cx + d$, $ax + b < cx + d$, $ax + b \geq cx + d$ and $ax + b \leq cx + d$. • Represents the integral solution sets of the inequalities $ax + b > cx + d$, $ax + b < cx + d$, $ax + b \geq cx + d$ and $ax + b \leq cx + d$ on a number line. • Finds the intervals of solutions of the inequalities $ax + b > cx + d$, $ax + b < cx + d$, $ax + b \geq cx + d$ and $ax + b \leq cx + d$. • Represents the intervals of solutions of the inequalities $ax + b > cx + d$, $ax + b < cx + d$, $ax + b \geq cx + d$ and $ax + b \leq cx + d$ on a number line. • Recognizes that inequalities of the form $ax+b \lessgtr cx+d$ can be used to represent certain applications of day to day life. • Uses inequalities of the form $ax+b \lessgtr cx+d$ to solve problems in day to day life.	**06**
Competency – 20 Easily communicates the mutual relationships that exist between two	**20.1** Solves problems using graphical methods.	• Solving a pair of simultaneous equations • Using graphs	• Draws the graphs of a pair of equations of the form $ax + by = c$ on the same coordinate plane. • Gives reasons why the solution to a pair of simultaneous equations of the form $ax + by = c$	**03**

variables by exploring various methods.			is given by the coordinates of the intersection point of their graphs. • Solves day to day problems involving pairs of simultaneous equations using the knowledge of graphs.	
	20.2 Analyzes the properties of a quadratic function by considering its graph.	• Quadratic functions of the form $y = ax^2 + bx + c$ ($a, b, c \in$ Q and $a \neq 0$) • Drawing the graph • Using the graph • The behavior of the function • Maximum/minimum value • Coordinates of the turning point • Equation of the axis of symmetry • Roots (When $y = 0$)	• Calculates the y values corresponding to several given x values of a function of the form $y = ax^2 + bx + c$ when $a, b, c \in$ Q and $a \neq 0$. • Draws the graph of a function of the form $y = ax^2 + bx + c$ for a given domain. • Using the graph of a function of the form $y = ax^2 + bx + c$, finds the interval of values of x for which the function is negative or negative and decreasing or negative and increasing or positive or positive and increasing or positive and decreasing. • Using the graph of a function of the form $y = ax^2 + bx + c$, finds the values of x corresponding to a given value of the function. • Using the graph of a function of the form $y = ax^2 + bx + c$, finds the interval of values of x corresponding to a given interval of values of the function. • Finds the maximum/minimum value, equation of the axis of symmetry and the coordinates of the turning point of a function of the form $y = ax^2 + bx + c$, using its graph.	**06**

			• By considering the graph of a function of the form $y = ax^2 + bx + c$, finds the roots of the equation $y = 0$. • Draws the graphs of functions of the form $y = \pm (x \pm b)^2 + c$ and $y = \pm(x \pm a)(x \pm b)$ for a given domain. • Describes the properties of functions of the form $y = \pm (x \pm b)^2 + c$ and $y = \pm(x \pm a)(x \pm b)$ by considering its graph.	
	20.3 Analyzes the properties of a quadratic function by observing the function.	• Properties of quadratic functions of the form $y = \pm (x \pm b)^2 + c$ and $y = \pm(x \pm a)(x \pm b)$ (Without drawing the graph)	• Finds the inter-relationships between a function of the form $y = \pm (x \pm b)^2 + c$ and its graph. • Determines the maximum/minimum value, the equation of the axis of symmetry and the coordinates of the turning point of a function of the form $y = \pm (x \pm b)^2 + c$ by observing the function. • Finds the inter-relationships between a function of the form $y = \pm(x \pm a)(x \pm b)$ and its graph.	**03**
	20.4 Manipulates matrices under the basic mathematical operations.	• Matrices • Introduction (Up to 3 × 3) • Adding and subtracting (Up to 3 × 3)	• Identifies a matrix as a method of presenting information in rows and columns. • Recognizes that the order of a matrix is given by the number of rows and the number of columns of the matrix.	08

		• Multiplying a matrix by a scalar (Up to 3 × 3) • Multiplying two matrices (Up to 2 × 2)	• Recognizes row matrices, column matrices, square matrices, unit matrices and symmetric matrices. • Understands through practical situations that to add or subtract matrices, their orders should be equal. • Adds two row/column matrices of the same order, subtracts a row/column matrix from a row/column matrix of the same order. • Adds and subtracts matrices of the same order up to matrices of order 3 × 3. • Gives reasons why two given matrices can/cannot be added or subtracted. • Multiplies a matrix of order up to 3 × 3 by an integer. • Simplifies matrices under the operations of addition, subtraction and multiplication by an integer. • Understands that to multiply two matrices, the number of columns of the first matrix should be equal to the number of rows of the second matrix. • Multiplies two matrices of order up to 2 × 2 . • Gives reasons why two given matrices can/cannot be multiplied. • Solves problems encountered in day to day life	

			using the knowledge on matrices.	
Geometry **Competency – 23** Makes decisions regarding day to day activities based on geometrical concepts related to rectilinear plane figures.	**23.1** Finds relationships between the areas of parallelograms and triangles that lie between the same parallel lines.	• The areas of triangles and parallelograms that lie between two parallel lines • Applying the theorem, "Parallelograms on the same base and between the same parallel lines are equal in area" (Proof not expected) • Applying the theorem, "If a parallelogram and a triangle stand on the same base and are between the same parallel lines, then the area of the triangle is half that of the parallelogram" (Proof not expected)	• Names triangles and parallelograms on the same base and between the same parallel lines. • Identifies the theorem, "Parallelograms on the same base and between the same parallel lines are equal in area". • Verifies the theorem, "Parallelograms on the same base and between the same parallel lines are equal in area". • Performs calculations using the theorem, "Parallelograms on the same base and between the same parallel lines are equal in area". • Proves riders using the theorem, "Parallelograms on the same base and between the same parallel lines are equal in area". • Identifies the theorem, "If a parallelogram and a triangle stand on the same base and are between the same parallel lines, then the area of the triangle is half that of the parallelogram". • Verifies the theorem, "If a parallelogram and a triangle stand on the same base and are between the same parallel lines, then the area of the triangle is half that of the parallelogram". • Performs calculations using the theorem, "If a parallelogram and a triangle stand on the same base and are between the same parallel lines, then the area of the triangle is half that of the	**06**

			parallelogram". • Proves riders using the theorem, "If a parallelogram and a triangle stand on the same base and are between the same parallel lines, then the area of the triangle is half that of the parallelogram".	
	23.2 Uses the relationship between the areas of triangles on the same base when making decisions.	• Applying the theorem, "Triangles on the same base and between the same parallel lines are equal in area" (Proof not expected)	• Identifies the theorem, "Triangles on the same base and between the same parallel lines are equal in area". • Verifies the theorem, "Triangles on the same base and between the same parallel lines are equal in area". • Performs calculations using the theorem, "Triangles on the same base and between the same parallel lines are equal in area". • Proves riders using the theorem, "Triangles on the same base and between the same parallel lines are equal in area".	**06**
	23.3 Investigates the relationship between the sides of a triangle and parallelism.	• Applying the following theorem and its converse, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally". (Proof not expected)	• Identifies the theorem, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally". • Verifies the theorem, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally". • Performs calculations using the theorem, "The	**06**

			straight line drawn parallel to a side of a triangle cuts the other two sides proportionally". • Proves riders using the theorem, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally". • Identifies the converse of the theorem, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally". • Performs calculations using the converse of the theorem, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally". • Proves riders using the converse of the theorem, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally".	
	23.4 Investigates the equi-angularity of two triangles.	• Equi-angular triangles and similar triangles • Instances when two triangles are equi-angular • Applying the following theorem and its converse, " The corresponding sides of two equi-angular triangles are proportional" (Proof not expected)	• Identifies similar triangles. • Identifies equi-angular triangles. • Understands that equi-angular triangles are similar triangles. • Names the pairs of corresponding sides of equi-angular triangles. • Identifies the theorem, "The corresponding sides of two equi-angular triangles are proportional".	**06**

			• Verifies the theorem, "The corresponding sides of two equi-angular triangles are proportional". • Performs calculations using the theorem, "The corresponding sides of two equi-angular triangles are proportional". • Proves riders using the theorem, "The corresponding sides of two equi-angular triangles are proportional". • Performs calculations using the converse of the theorem, "The corresponding sides of two equi-angular triangles are proportional". • Proves riders using the converse of the theorem, "The corresponding sides of two equi-angular triangles are proportional".	
	23.5 Investigates the relationship between the sides of a right-angled triangle.	• Applying Pythagoras' Theorem (Proof not expected)	• For a right-angled triangle, separately names the hypotenuse and the sides which include the right angle. • Identifies Pythagoras' theorem. • Performs calculations using Pythagoras' theorem. • Proves riders using Pythagoras' theorem. • Has an awareness of Pythagorean triples which are whole numbers.	**04**
	23.6 Investigates the results of dividing the	• Applying and proving the mid-point theorem	• Separately names the straight line which joins the mid-points of two sides of a triangle and the	**05**

	sides of a triangle according to a ratio.	• Applying the converse of the mid-point theorem (Proof not expected)	third side. • Identifies the mid-point theorem. • Verifies the mid-point theorem. • Performs calculations using the mid-point theorem. • Proves riders using the mid-point theorem. • Formally proves the mid-point theorem. • Identifies the converse of the mid-point theorem. • Performs calculations using the converse of the mid-point theorem. • Proves riders using the converse of the mid-point theorem.	
Competency – 24 Thinks logically to make decisions based on geometrical concepts related to circles.	**24.1** From among all quadrilaterals, investigates those that can be inscribed within a circle.	• Cyclic quadrilaterals • Applying and proving the theorem, "The opposite angles of a cyclic quadrilateral are supplementary" • Applying the theorem, "If a pair of opposite angles of a	• Writes down the pairs of opposite angles of a cyclic quadrilateral. • Identifies the theorem, "The opposite angles of a cyclic quadrilateral are supplementary". • Verifies the theorem, "The opposite angles of a cyclic quadrilateral are supplementary". • Performs calculations using the theorem, "The opposite angles of a cyclic quadrilateral are supplementary".	**05**

		quadrilateral are supplementary, its vertices are con-cyclic" (Proof not expected)	• Proves riders using the theorem, "The opposite angles of a cyclic quadrilateral are supplementary" • Formally proves the theorem, "The opposite angles of a cyclic quadrilateral are supplementary" • Identifies the theorem, "If a pair of opposite angles of a quadrilateral are supplementary, its vertices are con-cyclic". • Proves riders using the theorem, "If a pair of opposite angles of a quadrilateral are supplementary, its vertices are con-cyclic".	
	24.2 Investigates the relationships between the exterior and interior angles of a cyclic quadrilateral.	• Applying the theorem, "If one side of a cyclic quadrilateral is produced, the exterior angle so formed is equal to the interior opposite angle of the quadrilateral" (Proof not expected)	• Identifies the theorem, "If one side of a cyclic quadrilateral is produced, the exterior angle so formed is equal to the interior opposite angle of the quadrilateral". • Verifies the theorem "If one side of a cyclic quadrilateral is produced, the exterior angle so formed is equal to the interior opposite angle of the quadrilateral". • Performs calculations using the theorem, "If one side of a cyclic quadrilateral is produced, the exterior angle so formed is equal to the interior opposite angle of the quadrilateral". • Proves riders using the theorem, "If one side of a cyclic quadrilateral is produced, the exterior angle so formed is equal to the interior opposite angle of the quadrilateral".	**05**

	24.3 Formally establishes the behavior of the angles related to tangents of circles.	• Tangents • Applying the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle" (Proof not expected) • Applying the converse of the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle" (Proof not expected)	• Identifies the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle". • Verifies the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle". • Performs calculations using the theorem, ""The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact is a tangent to the circle". • Proves riders using the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle". • Identifies the converse of the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle". • Verifies the converse of the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle". • Performs calculations using the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle".	**04**

			• Proves riders using the converse of the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact is a tangent to the circle".	
	24.4 Investigates the properties of tangents drawn to a circle from a point outside the circle.	• Applying and proving the theorem "If two tangents are drawn to a circle from an exterior point, then, i. the two tangents are equal to each other in length ii. the tangents subtend equal angles at the centre iii. the angle between the tangents is bisected by the straight line joining the exterior point to the centre"	• Identifies the theorem, "If two tangents are drawn to a circle from an exterior point, then, i. the two tangents are equal to each other in length ii. the tangents subtend equal angles at the centre iii. the angle between the tangents is bisected by the straight line joining the exterior point to the centre" • Verifies the above theorem. • Performs calculations using the above theorem. • Proves riders using the above theorem. • Formally proves the theorem.	**04**
	24.5 Investigates the relationship between the angle between the tangent and a chord and the angle in the alternate	• Introducing the angle in the alternate segment • Applying the theorem, "The angles which a tangent to a circle makes with a chord drawn from the point of	• Identifies the angle in the alternate segment. • Identifies the theorem, "The angles which a tangent to a circle makes with a chord drawn from the point of contact are respectively equal to the angles in the alternate segments of the circle". • Verifies the theorem, "The angles which a	**02**

	segment.	contact are respectively equal to the angles in the alternate segments of the circle" (Proof not expected)	tangent to a circle makes with a chord drawn from the point of contact are respectively equal to the angles in the alternate segments of the circle". • Performs calculations using the theorem, "The angles which a tangent to a circle makes with a chord drawn from the point of contact are respectively equal to the angles in the alternate segments of the circle". • Proves riders using the theorem, "The angles which a tangent to a circle makes with a chord drawn from the point of contact are respectively equal to the angles in the alternate segments of the circle".	
Competency – 27 Analyzes according to geometric laws, the nature of the locations in the surroundings.	**27.1** Constructs circles related to triangles.	• Using a straight edge and a pair of compasses • constructing the circum-circle of a triangle • constructing the in-circle of a triangle • constructing the escribed circle of a triangle	• Using a straight edge and a pair of compasses, constructs the perpendicular bisector of a straight line, the bisector of a given angle, a line perpendicular to a given line from a point on the line, a line perpendicular to a given line from a point outside the line. • Constructs the circum-circle of a triangle. • Identifies the location of the circum-centre of a right angled triangle. • Identifies the location of the circum-centre of an acute angled triangle. • Identifies the location of the circum-centre of an obtuse angled triangle. • Constructs the in-circle of a triangle. • Constructs the escribed circle of a triangle.	**03**

	27.2 Constructs tangents to a circle using the relationships between the angles related to tangents.	• Constructing a tangent to a circle from a point on the circle. • Constructing tangents to a circle from an external point	• Constructs a tangent to a circle from a point on the circle. • Constructs tangents to a circle from an external point. • Verifies the properties of the theorems on tangents by using the above constructions.	**02**

Statistics
 	
Competency – 28
Facilitates daily work by investigating the various methods of representing data.
	28.1
	Represents data graphically.
		• Representing data
		  • Class limits and class boundaries
		  • Histogram (Equal/unequal class intervals)
			• Identifies the class limits and class boundaries of a frequency distribution.
			• Explains the difference between the class limits and class boundaries of a frequency distribution.
			• Finds the class limits and class boundaries of a frequency distribution.
			• Represents by a histogram, the information in a frequency distribution of continuous data in equal sized class intervals.
			• States that the area of each column of a histogram represents the corresponding frequency (f).
			• Finds the size of a class interval as a multiple of the size of the smallest class interval, for a frequency distribution in unequal class intervals, using $\frac{\textit{size of class interval}}{\textit{size of smallest class interval}} = n$.
			• When drawing a histogram for a frequency distribution in unequal class intervals, obtains the height of the column over a class interval
				03

			using $\frac{f}{n}$. • Represents by a histogram, the information in a frequency distribution of continuous data in unequal sized class intervals. • Writes the relevant class boundaries of each class interval for a discrete frequency distribution. • Represents the information related to a discrete frequency distribution in a histogram.	
	28.2 Develops connections between the graphical representations of data.	• Representing data • Frequency polygon	• Draws the frequency polygon using the histogram. • Accepts that the area of the frequency polygon is equal to the area of the histogram. • Draws the frequency polygon using the mid-point of each class interval and the corresponding frequency. • Gives reasons why when drawing a frequency polygon, the midpoint of the interval before the first class interval is joined to the upper midpoint of the column over the first class interval and the midpoint of the interval after the last class interval is joined to the upper mid-point of the column over the last class interval, and the upper mid-point of each of the other columns are joined to the upper midpoints of the columns on the two sides.	**03**

			• States that when a frequency polygon is being drawn, after the midpoint of the interval before the first class interval, the upper midpoints of the columns over the class intervals and the midpoint of the interval after the last class interval are joined, the polygon is completed by joining the end two points along the horizontal axis.	
	28.3 Represents the relationship between the cumulative frequency of a group of data and the boundaries.	• Representing data • Cumulative frequency curve	• Obtains the values of the cumulative frequency column by adding the values in the frequency column of a frequency distribution from top to bottom or from bottom to top. • Draws the cumulative frequency curve by using the upper boundary of each class interval and the cumulative frequency of the relevant class interval.	**03**
Competency – 29 Makes predictions after analyzing data by various methods to facilitate daily activities.	**29.1** Uses quartiles and the inter-quartile range to interpret data represented by a cumulative frequency curve.	• Interpreting data • Introducing quartiles and the inter-quartile range	• Explains quartiles as the values at which a frequency distribution is divided into four equal parts. • Identifies the value in the $\left(\frac{n+1}{4}\right)^{th}$ position of a set of n values, when the data is arranged in ascending order, as the **first quartile** (Q_1). • Identifies the value in the $\frac{1}{2}(n+1)^{th}$ position of a set of n values, when the data is arranged in ascending order, as the **second quartile** (Q_2). • Identifies the value in the $\frac{2}{4}(n+1)^{th}$ position of a set of n values, when the data is arranged in	**03**

		• Cumulative frequency curve (For grouped and ungrouped data) • Quartiles • Inter-quartile range	ascending order, as the **third quartile** (Q_3). • Shows that the second quartile (Q_2) is the median of a group of data. • Identifies the **inter quartile range** of a group of data as the third quartile – the first quartile ($Q_3 - Q_1$). • Accepts that when the top 25% and the bottom 25% of a group of data arranged in ascending order are removed, the remaining range of values is the inter-quartile range. • Using the cumulative frequency curve, finds the first quartile (Q_1) as the value in the $\left(\frac{1}{4}n\right)^{\text{th}}$ position when the frequency is n. • Using the cumulative frequency curve, finds the second quartile (Q_2) as the value in the $\left(\frac{1}{2}n\right)^{\text{th}}$ position when the frequency is n. • Using the cumulative frequency curve, finds the third quartile (Q_3) as the value in the $\left(\frac{2}{4}n\right)^{\text{th}}$ position when the frequency is n. • Calculates the inter-quartile range by using the first and third quartiles. • Uses quartiles and the inter-quartile range to solve problems in daily life.	

Sets and Probability				
Competency – 30 Manipulates the principles related to sets to facilitate daily activities.	**30.1** Uses Venn diagrams to solve problems related to sets.	• Sets • Using Venn diagrams (for three sets) • Identifying the regions relevant to the union and intersection of sets and the complement of a set • Solving problems	• Draws the various ways of representing three sets in a Venn diagram. • Describes in words the set which is denoted by a shaded region in a Venn diagram of three sets. • Represents using set notations a set which is denoted by a shaded region in a Venn diagram of three sets. • Shades a region that has been described in words in a Venn diagram of three sets. • Shades a region that has been given in set notations, in a Venn diagram of three sets. • Using a Venn diagram, solves problems that can be represented using three sets.	**06**
Competency – 31 Analyzes the likelihood of an event occurring to predict future events.	**31.1** Interprets day to day events using various methods of representing the likelihood of occurrence.	• The sample space of a random experiment (Including dependent events) • Representing on a grid • Representing on a tree diagram • Solving problems involving dependent events using a grid and a tree diagram	• Describes the nature of a dependent event. • Provides examples of dependent events. • Distinguishes and identifies dependent and independent events. • Represents the sample space of a random experiment involving dependent events on a grid. • Writes down the probability of a given event using the representation on a grid of the sample space of a random experiment involving dependent events. • Solves problems involving dependent events using a grid.	**07**

			• Represents on a tree diagram, all the possible events of a random experiment involving 2 stages of dependent events. • States that the sum of all the probabilities on the branches of a tree diagram is 1 (one) for each stage. • Solves problems involving dependent events using a tree diagram.	
			Total	**190**

Lesson Sequence

Content	Competency Levels	Number of Periods
1st term		
1. Real Numbers	1.1, 1.2, 1.3	10
2. Indices and logarithms - I	6.1, 6.2	08
3. Indices and logarithms - II	6.3, 6.4 (a part)	06
4. Surface area of solids	8.1	05
5. Volume of solids	10.1	05
6. Binomial expressions	14.1	04
7. Algebraic fractions	16.1	04
8. Area of plane figures between parallel lines	23.1, 23.2	12
		54
2nd term		
9. Percentages	5.1, 5.2	06
10. Share Market	5.3	05
11. Central limit theorem	23.6	05
12. Graphs	20.1, 20.2, 20.3	12
13. Equations	17.1, 17.2	10
14. Eqiangular triangles	23.3, 23.4	12
15. Data representaion and prediction	28.1, 28.2, 28.3, 29.1	12
16. Geometric progression	2.1	06
		68
3rd term		
17. Pythagoras theorem	23.5	04
18. Trigonometry	13.1, 13.2, 6.4 (a part)	12
19. Matrices	20.4	08
20. Inequalities	18.1	06
21. Cyclic quadrilaterals	24.1, 24.2	10
22. Tangents	24.3, 24.4, 24.5	10
23. Constructions	27.1, 27.2	05
24. Sets	30.1	06
25. Probability	31.1	07
		68
	Total	190

Instructions for the Learning-Teaching Evaluation Process

1. Rational Numbers

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

Competency level 1.1: Analyses the set of rational numbers.
Competency level 1.2: Analyses the set of real numbers.
Competency level 1.3: Manipulates the basic mathematical operations in relation to surds

No. of Periods : 03

Introduction :

- Rational numbers are those that can be represented as $\frac{p}{q}$ when p and q are integers and $q \neq 0$.
- A set of rational numbers is symbolized as Q
- Rational numbers include any fraction that is finite or recurring and intergers.
- In the denominator of a fraction that gives a finite decimal, powers of 2 or 5 or both 2 and 5 exist as factors.
- In the denomenator of a fraction giving a recurring decimal, powers of one or more prime numbers that are not 2 or 5 exist as factors.
- The numbers that cannot be represented in the form $\sqrt{2}$, $\sqrt{3}$ or $\frac{p}{q}$ are called irrational numbers.
- A set of irrational numbers is symbolized as Q'.
- A set consisting of rational and irrational numbers is a set of real numbers.
- A real number set is sumbolized as R.
- Real numbers can be represented in a number line.

Learning outcomes relevant to competency level 1.1:

1. **Distinguishes fractions which are terminating decimals from those which are recurring decimals by simplifying given fractions**

2. **Selects fractions which are terminating decimals and those which are recurring decimals by examining the denominator.**

3. Accepts that fractions of the form $\frac{p}{q}$ where p and q are integers with $q \neq 0$, are either terminating decimals or recurring decimals.
4. States that fractions of the form $\frac{p}{q}$ where p and q are integers with $q \neq 0$ are rational numbers (Q)
5. Gives reasons for integers are also rational numbers.

Glossary of terms:

Finite decimals	-	අන්ත දශම	-	முடிவுறு தசமம்
Recurring decimals	-	සමාවර්ත දශම	-	மீளும் தசமம்
Infinite decimals	-	අනන්ත දශම	-	முடிவில் தசமம்
Integers	-	නිඛිල	-	நிறைவெண்கள்
Surds	-	කරණී	-	சேடு
Entire surd	-	අඛිල කරණ	-	முழுமைச் சேடு
Rational numbers	-	පරිමේය සංඛ්‍යා	-	விகிதமுறு எண்கள்
Irrational numbers	-	අපරිමේය සංඛ්‍යා	-	விகிதமுறா எண்கள்
Real numbers	-	තාත්ත්වික සංඛ්‍යා	-	மெய்யெண்கள்

Instructions to plan the lesson:

Given is a learning specimen prepared to build up the subject concepts relevant to the learning outcomes 1 and 2 under the competency level 1.1, and enable students to distinguish finite decimals and recurring decimals throguh exploration.

Time : 40 minutes

Quality inputs :

- Copies of the activity sheet I
- Copies of the activity sheet II (for the game)

Instructions for the teacher :

Approach :

- Recall in students about the factors of a number and its prime factors through examples.
- Asking students about the conversion of a factor instruct them to convert fraction such as $\frac{1}{2}$ and $\frac{1}{4}$ into decimals.
- Stating that decimals obtained from fractions may be of various types, guide students to do the following activity to explore it.
- Divide the class into groups as appropriate and assign them the due tasks distributing activity sheet -I to each group.

Development of the lesson:

- Conduct a discussion surfacing the following facts and giving opportunities to present students' findings.
    - Threre are two forms in the decimal numbers obatained by converting fractions into decimals.
    - The two froms are called finite decimals and recurring decimals.
    - Only the powers of 2 or 5 or 2 and 5 exist in the denomenator of a fraction giving a finite decimal.
    - Recurring decimal includes powers of other prime numbers excepting 2 and 5.
    - Accordingly, the finite or recurring nature of the decimal number obtained from a fraction can be identified by examining its denomenator.
- After the discussion distribute the second activity sheet and engage the students in the game individually on the condition of finishing it within 5 minutes.
- In order to establish the learnt facts in students, explain with examples that, if a fraction has factors in its denominator and numerator, such as $\frac{6}{30}$, the denominator has to be examinied after simplying the fraction.
- Using the examples such as $\frac{7}{360}, \frac{1}{30}$ and $\frac{11}{1500}$, when the denominator is power of 10, since the multiple of 10 is power of 2 and 5 only, necessary to find the prime factor of the number obtained dividing from the power of 10.

Student Activity sheet I :

- Of the groups of numbers A, B, C, D in the following table, distribute among the group members the number set assigned to your group.

A	4, 6, 9, 10, 3, 8, 7, 25
B	5, 6, 10, 11, 8, 9, 7, 25
C	5, 9, 6, 8, 10, 12, 7, 25
D	3, 4, 6, 10, 8, 12, 7,25

- Write fractions so that each number you received is the denomenator of them.

- Decimalise the fractions you wrote (If there is no residue on division, continue division).
- Devide all the decimal numbers your group obtained into two categories according to their characteristics.
- Suggest suitable names for those two categories and a way to write those decimal numbers.
- Complete the following table placing the denomenators of the fractions you decimalised and the prime factors of those denominators.

Denomenator	Prime factors of denomenator	Decimal number obtained from the fraction

- Investigating with the group whether the type of the decimal number obtained by converting a fraction can be decided by observing its denomenator, get ready to present your finding to the whole class.

Student activity sheet II :

- Divide the fractions given in the folloiwng table into finite decimals and recurring decimals and complete the other table inserting the fractions so obtained.

You get only five minutes for this task.

$\frac{2}{5}$	$\frac{2}{3}$	$\frac{5}{7}$	$\frac{5}{8}$	$\frac{7}{12}$	$\frac{4}{9}$	$\frac{5}{21}$	$\frac{7}{32}$	$\frac{3}{4}$	$\frac{8}{33}$
$\frac{23}{50}$	$\frac{17}{30}$	$\frac{5}{81}$	$\frac{31}{64}$	$\frac{7}{360}$	$\frac{1}{35}$	$\frac{11}{40}$	$\frac{53}{128}$	$\frac{7}{120}$	$\frac{3}{80}$

Finite decimals										
Recurring decimals										

Awarding marks : +01 for a correct selection
-01 for an incorrect selection

Assessment and Evaluation :

- Assessment Criteria
  - Identifies two types of decimals obtained from a given fraction as finite decimals or recurring decimals.
  - Accepts that there is a relationship between the decimal type and the denomenator of the fraction giving rise to that decimal.
  - State that finite decimals are given by the fractions whose denomenator is a power of 2 or 5 or 2 and 5 while recurring decimals are produced by the fractions with a denomenator that includes a prime factor except 2 and 5.
  - Classifies the decimal number given by a fraction as finite or recurring by observing the denominator of that fraction.
  - Reinforces the facts learnt by engaging in a game.
- Direct students to the relevant exercises of the lesson 01st in the text book.

For your attention..

Development of the lesson:

- Taking finite decimals and recurring decimals into consideration and explaining the requirements of p and q in $\frac{p}{q}$, conduct an acitivity with students to introduce rational numbers.
- Through an appropirate activity, affirm in students that all integers are rational using the characteristics of the rational numbers.
- Plan lessons appropriately for the competency levels 1.2 and 1.3 and implement with students.

Assessment and Evaluation:

- Direct students to distinguish a given set of numbers as rational and irrational numbers
- Direct students to the relevant exercises of the lesson 01st in the textbook.

For further reference :

- http://www.youtube.com/watch?v=Ksu1lo312BM
- http://www.youtube.com/watch?v=d9pO2z2qvXU
- http://www.youtube.com/watch?v=aqslWLqIDhE
- http://www.youtube.com/watch?v=qfQv8GzyjB4
- http://www.youtube.com/watch?v=peyWUUkI-aw
- http://www.youtube.com/watch?v=BpBh8gvMIfs
- http://www.youtube.com/watch?v=6QJtWfIlyZo
- http://www.youtube.com/watch?v=egNq4tSfI1I

- http://www.youtube.com/watch?v=VWlFMfPVmkU
- http://www.youtube.com/watch?v=sBvRJUwXJPo
- http://www.youtube.com/watch?v=Z3d5itCliQ
- http://www.youtube.com/watch?v=gY5TvlHg4Vk

For the teacher only...

Conversion of a recurring decimal into a fraction can be done by the following method also

(i) 0.3

Zet X= 0.3

X=0.3 ——— (1)

(1) X 10; 10x= 3.3 ——— (2)

(2) – (1); 9x = 3

X=1/3

(ii) 0.45

Zet X= 0.45X ——— (1)

(1) X 100; 100x= 45 ——— (2)

(2) – (1); 99x = 45

$X=\frac{45}{99}=\frac{5}{11}$

(iii) 0.16

Zet X = 0.16

X= 0.16 ——— (1)

(1) X10; 10x=1.6 ——— (2)

(2) X10; 100x=16.6 ——— (3)

(3) - (2) ; 90x = 15

$X=\frac{15}{90}=\frac{3}{18}$

2. Indices and Logarithms I

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

Competency level 6.1: Solves equations containing powers with rational indices
Competency level 6.2: Solves equations involving logarithms

No. of periods : 08

Introduction:

Multiplication and division of powers with equal bases and simplification of instaces such as $(a^m)^n$ and $\sqrt[n]{a^m}$ have been learnt in the previous lessons under indices. Equations with indices are solved on the basis that indices are equal if the bases of two equal powers are equal and bases of two equal if the indices are equal. Using them, we can simplify expression of indices of base and can be written as logarithmic expressions where writing the base of the logarithm as log is a must. But, when writing the powers of 10 as logarithms, using only log is a special feature.
In multiplication, division and raising a power to a power, logarithmic simplifications are done under three relevant rules. This lesson is limited only for problems workable without using the logrithmic tables.

Learning outcomes relevant to competency level 6.1:

1. Writes a number expressed in the form $\sqrt[n]{a}$ in index form as $a^{\frac{1}{n}}$.
2. Simplifies expressions involving powers with rational indices.
3. States that if the bases of two equal powers are equal, then their indices are also equal.
4. States that if the indices of two equal powers are equal, then their bases are also equal.
5. **Solves equations involving powers with rational indices.**

Glossary of terms:

Index	-	දර්ශක	-	சுட்டி
Base	-	පාදය	-	அடி
Power	-	බලය	-	வலு
Logarithm	-	ලඝුගණක	-	மடக்கை

Instructions to plan the lesson :

With a view to imparting the ability of solving equations with rational indices relevant to the learning outcome 5 after establishing in students the subject knowledge pertaining to learning outcomes 1,2,3 and 4 an example under the guided inquiry method is given below.

Time : 40 minutes

Quality inputs :

- Copies of the activity sheet

Instructions for the teacher :

Approach :

- Displaying 5^3 on the board, discuss with students about the power, power of a power, powers with negative indices, base and multiplication and divisions of equal powers.
- Display the following table on the board and complete it dis cussing with students.

Number	16	9	27	81	8	64	625
As a power	4^2						
As a power of a power	$(2^2)^2$						

- Showing that when two powers with equal bases are equal and their indices are euqal and when two powers with equal indices are equal their bases are equal, guide the students for the following activity.

Development of the lesson :

- Divide the class into groups of four and distribute one activity sheet per group.
- Give instructions to complete the table taking the given steps into consideration and analysing the case.
- At the end of the activity, give an opportunity to present students' findings to the class.
- Conduct a discussion stating that when solving equation with indices, the terms on both sides of the equation should be brought under the same base and after simplifying till there are about two powers on both sides, the equation is solved taking into considreation the fact that indices are equal when bases are equal and bases are equal when indices are equal.

Activity sheet for the Students:

- Observe carefully how the following equation has been solved and discuss about its second and third steps in the group.

  $2^x = 16$
  $2^x = 2^4$ (converting to equal terms)
  $x = 4$ (equating indices because the bases are equal)

- Following the way the above equation is solved, copy the following problems (i) and (ii) in the exercise book and fill in the blanks.

(i) $2^x \times 16 = 64$
$2^x \times 2^{\cdots} = 2^{\cdots}$ (Converting to the same base)
$2^{x+\cdots} = 2^{\cdots}$ (Rule of multiplying indices)
$x + \ldots = \ldots$ (equating indices because of equal bases)
$x = 2$ (Solving the simple equation to get the answer)

(ii) $27^x \times 3^{x+1} = 243$
$(3^{\cdots})^x \times 3^{x+1} = 3^{\cdots}$ (expressing 2) and 243 as powers of 3)
$3^{\cdots} \times 3^{x+1} = 3^{\cdots}(\ldots\ldots\ldots\ldots)$
$3^{\cdots+x+1} = 3^{\cdots}(\ldots\ldots\ldots\ldots)$
$\ldots\ldots+x+1 = \ldots\ldots(\ldots\ldots\ldots\ldots)$
$x=1$

- Solve the following equations using what found in solving the above equations

  (i) $2^x \times 8^x = 64$ (iii) $x^2 =$

  (ii) $3^{x-1} \times 9 = 81$ (iv) $4^{-x} =$

- Prepare to present to the entire class the facts you descovered when solving equations with indices.

Assessment and Evaluation:

- Assessment Criteria:
  - Converts into two powers where the bases or indices on both sides are equal for solving equations with indices.
  - Accepts that the equality of bases or indices of two equal powers can be used to solve the equations that include indices.
  - Solves equations with integral indices
  - Solves equations with rational indices

- Learns by finding facts under guidance
- Direct students to the relevant exercises of the lesson 02nd in the textbook.

For your attention...

Development of the lesson :

- Plan and implement with students appropirate activities to simplify logarithmic expressions and solve logarithmic equations relevant to com petency level 6.2 without using logrithamic rules related to the power of a power and logarithamic tables.

Assessment and Evaluation:

- After stabilizing the concept of solving equations, direct the students to solve equations with such rational indices.
- Assign to students solving logarithamic equations and simplification of logarithamic expressions without using logarithamic tables.
- Direct students to the relevant exercises of the lesson 02nd in the text book.
- Get the students to refer to the problems that include expressions with indices, equations with indices, logarithamis expressions and logarithamic equations in the past examinlation papers.

For further reference:

- http://www.youtube.com/watch?v=JUGmvIJC_pk
- http://www.youtube.com/watch?v=zIRK021qEpQ
- http://www.youtube.com/watch?v=uggD8mwgIyc
- http://www.youtube.com/watch?v=JO4wOQQJVZg
- http://www.youtube.com/watch?v=qFFhdLIXZ2D
- http://www.youtube.com/watch?v=x6FFjIHPISI
- http://www.youtube.com/watch?v=TMmxIZaCqe0
- http://www.youtube.com/watch?v=yEAxG_D1HDw
- http://www.youtube.com/watch?v=Pb9V374iOas
- http://www.youtube.com/watch?v=RhzOX5PbsuQ
- http://www.youtube.com/watch?v=Kv2JHda7Xgw
- http://www.youtube.com/watch?v=oqAYqT70EBQ

03. Indices and Logarithms II

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

Competency level 6.3: Facilitates simplifications by using logarithm

Competency level 6.4: Uses the scientific calculator to solve mathematical prob lems including problems involving trigonometric ratios.

No. of periods : 06

Introduction

- The logarithmic table is prepared from the decimals obtained as the indices of the powers when the numbers from 1 to 10 are expressed as powers with base 10
- The characteristic of the logarithm of a negative value when it is less than 1, 0 when that number is between 1 and 10 and a positive value when it is 10 or greater than 10.
- The mantissa of a logarithm is always a positive value
- When indicating a logarithm with a negative characteristic ,it is written as follows to show that only the characteristic is negative e,g: The standard form of 0.05673 is 10^{-2} x 5.673 and its logarithm is, -2 + log 5.673 = -2 + 0.7538. It is written as $\bar{2}.7538$ and read as two bar point seven five thee eight.
- If logarithms with negative characteristics are subjected to basic mathematical operations it is simplified in a way similar to simlplification of directed numbers.
- Mathematical problems can be solved easily using logarithms
- Scientific calculator is a device that is used to simplify mathamatical problems easily
- Scientific calculator has a more complex key board than that of a normal calculator

Eg: shift, $\sqrt[x]{}$, sin, cos, tan, $\sin^{-1}$, tan^{-1}, cos^{-1}

Learning outcomes relavant to competency level 6.3:

1. **Writes the characteristic of the logarithm of a number between 0 and 1.**
2. Adds logarithms with negative characteristics.
3. Subtracts logarithms with negative characteristics .
4. Multiplies a logarithm with a negative characteristic by a whole number.
5. Divides a logarithm with a negative characteristic by a whole number.
6. Using the logarithms table, simplifies expressions of the form a^m where a is a decimal number and m is a whole number.
7. Using the logarithms table, simplifies expressions of the form $\sqrt[m]{a}$ where a is a positive decimal number and m is a whole number.
8. Using the logarithms table, simplifies expressions of the form $\frac{a^m \times \sqrt[n]{b}}{c}$ and $\frac{a^m \times b}{\sqrt[n]{c}}$ where a, b and c are positive decimal numbers and m and n are whole numbers.
9. Uses the logarithms table to facilitate simplifications when solving other mathematical problems.

Glossary of terms:

Scientific notation	-	විද්‍යාත්මක අංකනය	-	விஞ்ஞானமுறைக் குறிப்பீடு
Logarithm	-	ලඝුගණකය	-	மடக்கை
Characteristic	-	පූර්ණාංගය	-	சிறப் பியல் பு
Mantissa	-	දශමාංගය	-	தசமக்கூட்டு
Bar	-	වියුති	-	பிரிகோடு
Scientific calculator	-	විද්‍යාත්මක ගණකය	-	விஞ்ஞானமுறைக் கணிகருவி
Key	-	යතුරු	-	சாவி
Real numbers	-	තාත්වික සංඛ්‍යා	-	மெய் எண்கள்

Instruction to plan the lesson :

Given below is an example designed under the guided inquiry method to develop in students the subject concepts relevant to the learning outcome 1 under competency level 6.3

Time: 40 minutes

Quality inputs :

- Copies of the activity sheet

Instructions for the teacher:

Approach :

- Display a number between 1 and 10 and a number greater than 10 on the board and discuss about their logarithm, characteristic of the logarithm and mantissa with the students.
- Recall how the logarithm, its characteristic and mantissa were obtained in a number greater than1.
- Engage students in the following activity to make them identify the logarithm, its characteristic and mantissa of a number between 0 and 1 are obtained.

Development of the lesson:

- Group the students as appropirate and give one copy of the stu dent activity sheet to each group.
- Get the students to complete table 1 in the activity sheet while they are engaged in the activity. Afterwards, lead a discussion with students to explain the facts given below. Meanwhile give guidance to complete column D.
- Characteristic of the logarithm of a number between 0 and 1 is negative.
- Since the mantissa is positive, the negative character of only the characteristic should be shown.
- Writing $-2.....$, $\bar{2}....$ indicates that only 2 is negative
- $\bar{2}....$ is read as bar two
- Characteristics can be obtained from the scientific notation as well as the number of zeros coming after the decimal point of the number.
- The characteristic of a logarithm of a number between 0 and 1 is derived by the number of zeros coming after decimal point.
- While the students complete table 2 in the activity sheet, give guidance necessary and do the assessment

Acticity sheet for the students:

Copy Table 1 given below in your exercise book.

A	B	C		D
Number	Scientific Notation	Logarithm		Logarithm
		Characteristic	Mantissa	
3752	3.752×10^3	3	5742	
375.2	3.752×10^2	2	5742	
37.52				
3.752				
0.3752				
0.03752				
0.003752				

- Get all of the groups together and complete only the columns B and C of the table
- See whether there is any relationship between the scientific notation of a number and the characterisitc of its logrithm
- Observe the features of the characteristic of the logarithm belongingin to a number between 0 and 1 and a number greater than 1.
- Discuss in the group about amother method to obtain the characteristic of the logarithm of a number.
- Discuss in group about the problems arising when the characteristic and the mantissa of the logarithm of a number between 0 and 1 are written together.
- After completing table 1, present the facts discovered by group at the discussion led by the teacher.
- Copy table 2 in your exercise book and complete it using the facts you understood through the guidance of the teacher.

Number	Logarithm
0.759	
0.00873	
0.0104	
0.0005321	
0.004972	
0.9999	

- Suggest an easy method to get the characteristic of a logarithm between 0 and 1

Assessment and Evaluation:

- Assessment criteria.
  - Writes the characterisitc of the logarithm of a number between 0 and 1 in the scientific notation.
  - Accepts that of a logartith of a number between 0 and 1, the characteristic is negative and the mantissa is positive.
  - Writes the characteristic of the logarithm of a number between 0 and 1 using the number of zeros after the decimal point
  - Writes the logarithm of a given number between 0 and 1.
  - Uses strategies logically for correct communication.
- Direct the students to the relevant exercises of the lesson 3rd in the text book.

For your attention:

Development of the lesson:

- Design and Implement with student appropirate activities to develop the ability of finding powers and roots of num bers less than 1
- Through activities develop in students the ability of simplification of numbers including powers and roots
- Promote in students the ability of solving other mathemati cal problems drawing attention to the use of logarithmic tables.
- Plan and implement with students lessons for learning out comes related to logarithms under the competency level 6.4 also as appropirate.

Assessment and Evaluation:

- Direct students to simplify expressions that include num bers with powers and roots
- Direct students to solve mathematical problems that they encounter in other occations such as those under the theme measurement using logarithms.
- Direct students to the relevant exercises in the lesson 3rd in the text book.

For further reference:

- https://www.khanacademy.org/math/algebra2/logarithms-tutorial/logarithm_properties/v/logarithm-of-a-power
- https://www.khanacademy.org/math/algebra2/logarithms-tutorial/logarithm_basics/v/logarithms
- https://www.khanacademy.org/math/algebra2/logarithms-tutorial/logarithm_basics/e/logarithms_1.5

4. Surface area of soild objects

Competency 8 : Makes use of a limited space in an optimal manner by nvestigating the area

Competency level 8.1: Investigates the surface area of various solid objects in the environment.

Number of periods: 04

Introduction:

The surface area of a right pyaramid with square base is equal to the sum of the areas of the square which is the base and areas of the four triangular faces.

The surface area of a right circular cone of base radius 'r' and s lant height 'l' is equal to the sum of the area of the circle at the base and the area of the curved surface. Thus the surface area of the cone is given by .

The surface area of a sphere of radius r is given by

Learning outcomes relevant to competency level 8.1

1. **States that a square based right pyramid has four triangular faces apart from the square base.**
2. **Shows that the surface area *A* of a square based right pyramid with side length of the base equal to *a* and perpendicular height of a triangular face equal to *h* is given by $A = a^2 + 2ah$.**
3. Calculates the surface area of a square based right pyramid using the given data.
4. Calculates the perpendicular height of a triangular face when the length of a side of the square base and the altitude of the pyramid are given.
5. Solves problems related to the surface area of square based right pyramids.
6. States that a right circular cone is a solid object consisting of a curved surface and a flat circular base.
7. States that for a right circular cone, the straight line passing through the apex of the cone and the centre of the circular base is perpendicular to the base.

8. Accepts that the radius of the sector that forms the cone is equal to the slant height of the cone.

9. Accepts that the arc length of the sector that forms the cone is equal to the circumference of the base of the right circular cone.

10. States that the surface area of the curved surface of a right circular cone of base radius r and slant height l is πrl.

11. Shows that if the total surface area of a right circular cone of base radius r and slant height l is A then $A = \pi r^2 + \pi rl$.

12. Calculates the surface area of a right circular cone using the given data.

13. Calculates the surface area when the perpendicular height and the base radius of a right circular cone are given.

14. Solves problems related to the surface area of a right circular cone.

15. Recognizes that for a sphere of radius r, the surface area A is given by $A = 4\pi r^2$.

16. Calculates the surface area of a sphere when its radius r is given.

17. Calculates the radius of a sphere when its surface area is given.

18. Solves problems related to the surface area of a sphere.

Glossary of tems:

Square shaped	-	සමචතුරස්‍රාකාර	-	சதுர வடிவான
Traingular shaped	-	ත්‍රිකෝණාකාර	-	முக்கோணி வடிவான
Circular shaped	-	වෘත්තාකාර	-	வட்ட வடிவான
Area	-	වර්ගඵලය	-	பரப்பளவு
Surface area	-	පෘෂ්ඨ වර්ගඵලය	-	மேற்பரப்பளவு
Right pyramid	-	සෘජු පිරමීඩය	-	செங்கூம்பகம்
right circular cone	-	සෘජු වෘත්ත කේතුව	-	செவ்வட்டக்கூம்பு
Sphere	-	ගෝලය	-	கோளம்
Perpendicular height	-	ලම්බ උස	-	செங்குத்துயரம்
Slant height	-	ඇල උස	-	சாய் உயரம்
Radius	-	අරය	-	ஆரை
Curved surface	-	වක්‍ර පෘෂ්ඨය	-	வளை மேற்பரப்பு
Circumference	-	පරිධිය	-	பரிதி
Prism	-	ප්‍රිස්මය	-	அரியம்

Instruction to plan the lesson:

given below in an example prepared under the guided inquiry method to achieve the learning outcomes belonging to the competency levels 1 and 2.

Time : 40 minutes

Quality inputs:

- The right pyramid available in the mathematics laboratory or one made by the teacher
- Copies of the activity sheet
- Four solid right pyramids with a square base with measurements marked. (1 for a group)

Instructions for the teacher.

Approach:

- The pyramids that are symmetrical around the axis belong to right pyra mids. Show the square based right pyramid to the students and discuss about the faces.
- Draw the shapes of those faces on the board and lead a discussion on their area. Remind that the area of a square = 2x length of a side and area of a triangle = $\frac{1}{2}$ x base x perpendicular height

Development of the lesson:

- Divide the class into groups as appropriate and give each group an activity sheet and a pyramid
- Engage the students in the activity
- After finishing the students' work, ask how the surface area of the given pyramids can be obtained.
- If A is the surface area of a right pyramid where a is the length of the edge of the square base and h is the perpendicular height of a traingular face, direct students to find a common formula to find A.
- Discuss that the formula $A=a^2+2ah$ is derived.

Activity sheet for the students:

Your group is provided with a pyramid in which the length of a side of the square base and perpendicular height of a traingular face are marked.

- Find the area of the square base
- Find the area of a triangular face
- Find the area of the four tringular faces
- Find the surface area of the right pyramid given to you
- Get ready to present your findings

Assessment and Evaluation

- Assessment Criteria:
  - Accepts that a square-based right pyramid is made up of a square face and four similar triangular faces
  - Finds the area of the square base
  - Finds the area of triangular face
  - States that the area of the square-based right pyramid is equal to the sum of the area of the square base and the total of the areas of four trinegular faces around.
  - Carries out calculation using th fact that the surface area of a square-based right pyramid is given by $a^2 + 2ah$ where 'a' is the length of a side of the base and 'h' is the perpendicular height of a triangular face.
- Direct the students to the relevant exercises of the lesson 4th in the text book.

For your attention...

Development of the lesson:

- Plan and implement with students, suitable learning teaching strategies to develop learning outcomes from 3 to 18 related to the competency level 8.1

Assessment and Evaluation:

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

For further reference:

- https://www.khanacademy.org/math/basic-geo/basic-geo-volume-surface-area/basic-geo-surface-area/v/nets-of-polyhedra
- https://www.khanacademy.org/math/basic-geo/basic-geo-volume-surface-area/basic-geo-surface-area/e/nets-of-3d-figures

05. Volume of solid objects

Competency 10: Gets the maximum out of space by working critically with respect to volume

Competency level 10.1: Explores the volume of various solid objects

Number of periods: 05

Introduction

The space occupies by a solid object is known as its volume. In objects of uniform cross section such as prisms, cylinders and cuboids, the volume can be found by the product of the area of cross section and the height. The volume of a right circular cone of base-radius 'r' and perpendicular height 'h' is given by the formula $v = \frac{1}{3}\pi r^2 h$. When 'r' and 'h' change, the volume of the cone too changes. By the difference between the volume of a cylinder of radius 'r' and height '2r', it can be shown that the volume of a sphere of radius 'r' is $\frac{4}{3}\pi r^2$. The volume of a right pyramid with a square-base of side 'a' and perpendicular height 'h' is $\frac{1}{3}$ the volume of a cuboid with a square-base of side 'a' and height 'h' and it can be found by the formula $v = \frac{1}{3}a^2 h$. This lesson aims to solve problems related to the volument of the solid objects pyramids, cones and spheres.

Learning outcomes relevant to the competency level 10.1

1. States that for a right circular cone, if the base radius is *r*, the perpendicular height is *h* and the volume is *v*, then $v = \frac{1}{3}\pi r^2 h$
2. Calculates the volume of a cone using the given data.
3. Explains the change that occurs in the volume of a right cone when its radius *r* and its height *h* vary.
4. Solves problems related to the volume of a cone.
5. Discovers that the volume of the circumscribed cylinder of radius *r* and height 2*r* can be obtained from the sum of the volume of the sphere of radius *r* and the volume of a right cone of height 2*r* and base radius *r*.
6. Develops the formula $v = \frac{4}{3}\pi r^3$ for the volume *v* of a sphere of radius *r*.
7. Calculates the volume of a sphere using the given data.
8. Solves problems related to the volume of a sphere.

9. **Discovers that the volume of a pyramid of perpendicular height *h* and square base of side length *a* is $\frac{1}{3}$ the volume of a square based cuboid of height *h* and side length of the base *a*.**
10. **Develops the formula $v = \frac{1}{3}a^2h$ for the volume *v* of a pyramid of perpendicular height *h* with a square base of side length *a*.**
11. Calculates the volume of a square based pyramid using the given data.
12. Solves problems related to the volume of square based pyramids.

Glossary of terms:

volume	- පරිමාව	- கனவளவு
Cone	- කේතුව	- கூம்பு
Sphere	- ගෝලය	- கோளம்
pyramid	- පිරමීඩය	- கூம்பகம்
Perpendicular height	- ලම්බ උස	- செங்குத்துயரம்

Instructions to plan the lesson:

Given below is a examplar lesson plan designed to use the guided inquiry method with a view to achieveing the learning outcomes 9 and 10 of the competency level 10.1. Before that, adopt other suitable strategies using the equipment in the mathematics laboratory to reinforce subject matter related to the learning outcomes from 1 to 8 in students.

Time: 40 minutes

Quality inputs:

- A cuboid
- The transparent square-based pyramid provided to the maths laboratory or a right pyramid made by the teacher.
- The equipment (made by connecting a pyramid with a cube) available in the maths laboratory or a hollow cuboid and a pyramid with identical square-bases and equal heights made by the teacher.
- Copies of the activity sheet
- Fine sand in sufficient quantities

Instructions to the teacher:

Approach:

- Remind how the students found the volume of the objects such as cuboid, cube, rpism, cylinder and cone which they have learnt before.

Development of the lesson:

- Using the transparent right pyramid taken for the teacher demonstration, make the students well aware about the perpendicular height of the pyramid.
- Take a square-based cylinder of height 'h' and a side of the base 'a' and a square-based cuboid of height 'h' and a side 'a'. Fill the pyramid completely with find sand. Then empty the sand into the cuboid. Through this teacher demonstration convince students that sand fills upto about the height (Math ematics laboratories of some schools may have a special piece of equipment for this demonstration).
- Distribute the activity sheets and engage the students in the activity.
- After completion of the task elicit answers from the students to highlight that the volume of a square-based right pyramid of base side 'a' and perpendicular height 'h' given by $v = \frac{1}{3}a^2h$

Acitivity sheet for the Students:

- Complete the following activity sheet using your observation
- If 'a' is the side of the square base of the cuboid and 'h' is the height to which sand is filled, what is the relationship between 'x' and 'h'?
- Using the relationship between the volumes of the two solid objects you obtained , write the volume of the pyramid in terms of 'h' and 'a'
- Accordingly, construct a formula for the volume 'v' of a right pyramid whose side of the square base is 'a' and perpendicular height is 'h'

Assessment and Evaluation:

- Assessment criteria:
  - Demonstrates what is meant by the perpendicular height of a right pyramid
  - Derives a relationship between a cuboid and a pyramid whose bases are identical squares and perpendicular heights are equal.
  - If the side of the square base is 'a' and perpendicular height is 'h' and volume of the the pyramid is 'v' constructs accurately an expression for the volume of a right pyramid with a square base.
  - Acts coorperatively within the group
  - Does calculations related to the volume of a pyramid
- Direct the students to do the relevant exercises in the lesson 5th in the text book

For your attention...

Development of the lesson:

- Offer an opportunity for the students to find that the volume of a cone is given by $v = \frac{1}{3}2\pi r^2 h$ and to solve problems using the equipment available in the mathematics laboratory.
- Involve the students in the activity using the cylinder and cone to find that the volume of a sphere is $\frac{4}{3}\pi r^3$.

Assessment and Evaluation:

- Direct the students to work out the relevant exercises of the lesson 5th in the text book.

For further reference:

- http://www.youtube.com/watch?v=IelS2vg7JO8
- http://www.youtube.com/watch?v=DXRMVcoqRRQ

6. Binomial Expressions

Competency 14: Simplifies algebraic expressions by systematically exploring various methods

Competency level 14.1: Determines the cubes of binomial expressions

Number of periods: 04

Introduction:
We have identified that a binomial expressionis a sum of two algebraic terms. The third power of such a binomial expression is the cube of it. Thus

$(x+y)^3, (a-b)^3, (x+s)^3, (sx-1)^3$ are cubes.

In instances such as simplification of algebraic expressions, the cubed terms such as these need to be expanded. In this lesson, a general expression is derived to expand cubes and it is used to find the cube of various binomial algebraic expressions.

Learning outcomes relevant to competency level 14.1:

1. **Recognizes $x^3 + 3x^2y + 3xy^2 + y^3$ as the expansion of $(x + y)^3$**
2. **Expands cubes of binomial expressions of the form $(x + 5)^3$.**
3. Recognizes $x^3 - 3x^2y + 3xy^2 - y^3$ as the expansion of $(x - y)^3$
4. Accepts that the expansion of $(x - y)^3$ can be obtained by substituting (-y) for y in the expansion of $(x + y)^3$
5. Expands cubes of binomial expressions of the form $(x - 5)^3$

Glossary of terms:

Binomial expression	-	ද්විපද ප්‍රකාශන	-	ஈருறுப்புக் கோவை
Term	-	පදය	-	உறுப்பு
Expansion	-	ප්‍රසාරණය	-	விரிவு
Power	-	බලය	-	வலு
Squared	-	වර්ගයිකය	-	வர்க்கம்
Cubed	-	ඝනයිකය	-	கனம்

Instructions to plan the lesson:

A specimen individual activity designed to develop the subject concepts related to learning outcomes 1 and 2 under competency level 14.1 given below.

Time : 40 minutes

Quality inputs:

- An enlarged copy of the activity sheet
- Cellotape

Instructions for the teacher:

Approach:

- Emphasize to students that since

$$a^3 = a^2 \times a$$
$$y^3 = y^2 \times y$$

it can be written that $(x+y)^3 = (x+y)^2 \times (x+y)$,

- Also, get expressions such as,

$$(x+y)^2 = x^2 + 2xy + y^2$$
$$(x-y)^2 = x^2 - 2xy + y^2$$
$$(x+3)^2 = x^2 - 6x + 9$$

- Show that $a(b+c) = ab + ac$

Development of the lesson:

- Either write or display a magnified copy of the activity sheet to be com pleted given in annex 1 on the blackboard.
- Direct the students to copy the activity sheet and complete it.
- Analyse and discuss about the coefficients and signs of terms ob tained by the expansion of $(x+y)^3$
- Expalin that the cubes of other terms can be directly obtained using the final result of the expansion of $(x+y)^3$ with four terms.

Activity sheet for the Students:

- $(x+y)^3 = (x+y)^2(x+y)$

  $= (\ldots\ldots\ldots\ldots\ldots\ldots)(x+y)$

  $= x(\ldots\ldots\ldots\ldots\ldots\ldots) + y(\ldots\ldots\ldots)$

  $= \ldots\ldots\ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots +$

  $(x+y)^3 = \ldots\ldots\ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots$

- Taking into consideration the four terms obtained from $(x+y)^3$, complete the following.

  (i) $(a+b) = \ldots\ldots\ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots$

  (ii) $(m+n)^3 = \ldots\ldots\ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots$

  (iii) $(p+q)^3 = \ldots\ldots\ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots$

  (iv) $(a+2)^3 = a^3 + 3a^2 \times 2 + 3 \times \ldots\ldots \times 3^2 + 3^3$

  (v) $(x+3)^3 = a^3 + 6a^2 + \ldots\ldots\ldots\ldots + 3\ldots\ldots\ldots\ldots$

  (vi) $(x+z)^3 = \ldots\ldots\ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots$

  (vii) $(x+s)^3 = \ldots\ldots\ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots$

Assessment and Evaluation:

- Assessment Criteria:
  - Obtains the cube of (x+y) by expansion
  - Becomes mindful about the coefficients and signs of the four terms re sulted by cubing
  - Identifies $x^3 + 3x^2y + 3xy^3 + y^3$ as the expansion of $(x+y)^3$
  - Writes the cube of other two algebraic terms of coefficient 1 using the expansion of $(x+y)^3$.
  - Writes the cube of an algebraic term of coefficient 1 and a positive num ber
- Direct the students to work out the relevant exercises of the lesson 6th in the textbook.

For your attention....

Development of the lesson:

- Using an appropriate method discuss with students the fact that the expansion of $(x-y)^3$ is $x^3 - 3x^2y + 3xy^2 - y^3$ in relation to the learning outcome 3.

- In relation to the learning otucome 4, show that substituting (-y) for y in $(x + y)^3$, the expansion of $(x - y)^3$ can be obtained.

- In relation to the learning outcome 5, engage students in suitable exercises of finding the cube of expressions like $(x - 5)^3$ and reinforce learning.

Assessment and Evaluation:

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

For further refernce

- https://www.youtube.com/watch?v=NLQmQGA4s3M
- https://www.youtube.com/watch?v=TcB-ypKj8ZI

07. 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: Manipulates algebraic fractions under the operations of multiplication and division.

Number of periods: 04

Introduction:
In grade 10, students have learnt additon and subtraction. Competency level 16.1 aims mastering of multification and division of algebraic fractions. Multiplication of algebraic fractions can be done in the same way the common fractions are multiplied. If the deneminator and numerator of each algebraic fraction can be factorised, they are separated into factors. Later simplification can be done by dividng the denomenatior and numerator by the common factos if any. As is done in dividing a common fraction by another common fraction, when dividng an algebraic fraction by another algebraic fraction, division can be conberted to a multiplication by multiplying the first algebraic fraction by reciprocate of the second fraction (divisor) followed by simplification as is done in multiplication.

Learning outcomes relevant to competency level 16.1:

1. **Multiplies algebraic fractions with algebraic terms in the numerator or in the denominator or in both the numerator and the denominator.**
2. **Multiplies algebraic fractions with algebraic expressions in the numerator or in the denominator or in both the numerator and the denominator.**
3. Finds the reciprocal of an algebraic fraction.
4. Divides algebraic fractions with algebraic terms in the numerator or in the denominator or in both the numerator and the denominator.
5. Divides algebraic fractions with algebraic expressions in the numerator or in the denominator or in both the numerator and the denominator.
6. Simplifies expressions of algebraic fractions.

Glossary of terms:

Denominator	- හරය	-	பகுதி
Numerator	- ලවය	-	தொகுதி
Common Denominator	- පොදු හරය	-	பொதுப்பகுதி
Least Common multiple	- කුඩාම පොදු ගුණාකාරය	-	பொதுமடங்குகளுள் சிறியது
Reciprocal	- පරස්පරය	-	நிகர்மாறு
Multiplication	- ගුණ කිරීම	-	பெருக்கல்
Division	- බෙදීම	-	வகுத்தல்
Algbraic fractions	- වීජීය භාග	-	அட்சரகணிதப் பின்னங்கள்

Instructions to plan the lesson

A exemplar lesson plan based on the lecture-discussion method to help students to achieve the learning outcomes 1 and 2 of the competency level 16.1 is given below.

Time : 40 minutes

Instructions for the teacher:

Approach:

- Remind and discuss about the multiplication of two fractions giving rise to a single fraction including the instrances where there are common factors in the numerator and the denomenator.
- Discuss the factorisation of algebraic expressions.

Development of the lesson:

- Illustrate with examples the multiplication of algebraic fractions. Start the simplification from simple steps.

  Examples: $(i)\ \frac{x}{5}\times\frac{y}{3}$ $(ii)\ \frac{8}{ab}\times\frac{a}{2b}$

- Discuss problems that involve simplification by factorisation of the algebraic expression in the denomenator or numerator when multiplying algebraic fractions.

  Examples: $(iii)\ \frac{2x-6}{3x}\times\frac{1}{x-3}$

- Review the process that should be followed in muptiplying algebraic fractions.
- State that, when multiplying two algebraic fractions, it is done in the same way by which two common fractions are multiplied, denomenator and numerator of each fraction are factorised if possible, and if there are common factors in the denomenators and the numerators they can be removed by division.

Assessment and Evaluation :

- Assessment criteria:
  - Observes the common factors in the denomenators and numerators of algebraic fractions.
  - Points out the relationship between the process of multiplying algebraic fractions and the process of multiplying common fractions
  - Shows that when multiplying two algebraic factions, the common factors of the numerators and denomenators can be removed by dividing by them.
  - Multiplies two given algebraic fractions correctly.
  - Participates in discussions.
- Direct the students to do the relevant exercises of the lesson 7th in the text book.

For your attention...

Development of the lesson:

- Adopt suitable strategies to instill the subject matter related to learning out comes 3,4,5 and 6 in students.

Assessment and Evaluation:

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

For further reference:

- https://www.khanacademy.org/math/algebra-basics/core-algebra-expressions/al/v/algebraic-expressions-with-fraction-division

8. Plane figures between parallel lines

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

Competency level 23.1: Finds relationships between the areas of parallelo grams and triangles that lie between the same parallel lines.

Competency level 23.2: Uses the relationship between the areas of triangles on the same base when making decisions

Number of periods: 12

Introduction

The simplest closed figure that we encournter in plane geometry is the triangle. The congruent plane figure, lamina are invariably equal in area. But, we cannot say that, plane figures that are not congruent are not equal in area. Though not congruent, the equality in area of the triangles and parallelograms lying on the same base between the same parallel lines can be given as examples.

This section covers the identification and usage of the theorems stating that "the parallelograms lying on the same base between the same pair of parallel lines are equal in area and the area of a trinagle lying on the same base between the same pair of parallel lines half the area of the parallelogram and proof of riders.

Learning outcomes relevant to Competency level 23.1:

1. **Names triangles and parallelograms on the same base and be tween the same parallel line**

2. **Identifies the theorem, "Parallelograms on the same base and between the same parallel lines are equal in area".**

3. **Verifies the theorem, "Parallelograms on the same base and between the same parallel lines are equal in area".**

4. Performs calculations using the theorem, "Parallelograms on the same base and between the same parallel lines are equal in area".

5. Proves riders using the theorem, "Parallelograms on the same base and between the same parallel lines are equal in area".

6. Identifies the theorem, "If a parallelogram and a triangle stand on the same base and are between the same parallel lines, then the area of the triangle is half that of the parallelogram".

7. Verifies the theorem, "If a parallelogram and a triangle stand on the same base and are between the same parallel lines, then the area of the triangle is half that of the parallelogram".

8. Performs calculations using the theorem, "If a parallelogram and a triangle stand on the same base and are between the same parallel lines, then the area of the triangle is half that of the parallelogram".

9. Proves riders using the theorem, "If a parallelogram and a triangle stand on the same base and are between the same parallel lines, then the area of the triangle is half that of the parallelogram".

Glossary of terms:

Parallel lines	-	සමාන්තර රේඛා	- சமாந்தரக் கோடுகள்
Theorem	-	ප්‍රමේයය	- தேற்றம்
Paralleogram	-	සමාන්තරාස්‍රය	- இணைகரம்
Area	-	වර්ගඵලය	- பரப்பளவு
Same Base	-	එකම ආධාරකය	- ஒரே அடி
Triangle	-	ත්‍රිකෝණය	- முக்கோணி

Instructions to plan the lesson:

A exemplar lesson plan based on a teacher-guided group activity to develop the subject concepts relevant to learning outcomes 1, 2 and 3 under the competency level 23.1 is given below.

Time: 40 minutes

Quality inputs:

- Required number of copies of the activity sheet
- About 5cm x 5 cm oil papers

Instructions for the teacher:

Approach:

- Draw several parallelograms on the board and discuss how the area of them could be found.
- Discuss how the fact that coinciding plane figures are equal in area can be used in this regard.

Development of the lesson:

- Introduce the theorum "the parallelograms lying on the same base be tween the same parallel lines are equal in area.
- Group the students as appropriate
- Distribute a student activity sheet given in annex 1 and an oil paper to each group.
- At the end of the activity, discuss about the verification of the theorem with the students.

Activity sheet for the Students:

- Name the two parallelograms in Figure 1.

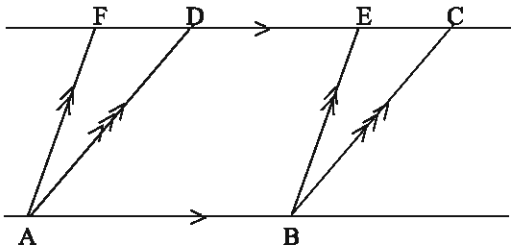


Figure 1

- Copy Figure 1 to an oil paper.
- By coinciding the trinagle BEC in the copies figure with the triangle ADF in the above figure, confirm that the triangles BEC and ADF are equal in area.
- Fill in the blanks below, show that the theorem learnt above is correct.

BEC = ...(According to coincidence)
BEC + ABED = ...+ ABED (Noticeable)
.....= .....(according ot the figure)

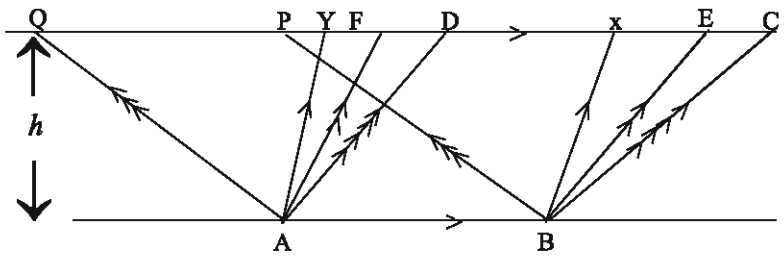


Figure 2

- Figure 2 shows several parallelograms drawn between the same pair of parallel lines.
- Using the figure, complete the table given.

Parallelogram	Area

- Write the conclusion that can be drawn according to the com pleted table.

Assessment and Evaluation:

- Assessment criteria
  - Identifies the parallelograms lying on the same base between the same pair of parallel lines.
  - Verifies that the prarallelograms lying on the same base be tween the same pair of parallel lines are equal in area
  - Accepts that the parallelograms lying on the same base between the same pair of parallel lines are equal in area.
  - makes correct decisions based on data
  - Presents ideas logically.
- Direct students to the relevant exercises of the lesson 08th in the textbook.

For your attention...

Development of the lesson:

- Plan a specimen lesson with teacher demonstrations for learning outcomes 4 and 5 relevant to completency level 23.1
- Plan lessons with student activities for learning outcomes 6,7,8 and 9
- Accordingly plan lessons for the competancy level 23.2 as appro priate

Assessment and Evaluation:

- Direct students to the relevant exercises of the lesson 08 th in the text book.

For further reference:

- https://www.youtube.com/watch?v=tTSUfyZm674

9. Percentages

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

Competency Level 5.1: Uses percentages when making transactions in installments

Competency Level 5.2: Makes transactions by comparing interest schemes

Number of periods: 04

Introduction

A Loan can be paid in installments. Paying loan amount per month has to be calculated. Monthly interest is calculated based on the interest rate. Under reducing balance method interest is calculated ignoring the paid loan amount. Considering the loan amount paid in a month as a unit, interest is calculated for few units. Accordingly if the number of installments are 'n', the number of months the interest to be paid can be calculated as follows; $\frac{n}{2}(n+1)$. The interest to be paid during the relevant time period is calculating using this equation. considering all above facts, monthly installment is calculated by dividing the summation of the loan amount and total interest by number of installments.

Compound interest is calculated considering the the summation of initial amount and first term interest as the initital amount for the next term. Consumer gets more benefits from compound interest than from reducing balance method. Compound interest is disadvantageous for borrowers.

Learning outcomes relevant to competency level 5.1:

1. Gives examples of situation where payments are made in installments.
2. **Calculates the interest considering the monthly amount based on the reducing balance.**
3. **If the number of installments for a loan amount is *n*, calculates the number of month units for which the interest needs to be paid, by using the formula $\frac{n}{2}(n+1)$.**
4. Calculates the interest considering the number of installments based on the reducing balance.
5. Calculates the total amount that should be paid to be free of the loan.

6. Calculates the value of an equal monthly installment by considering the total amount that needs to be paid.
7. Finds the interest rate charged for the loan amount when the value of an equal monthly installment is given.
8. Analyses practical situations where the reducing balance is used.

Glossary of terms:

Reducing Balance	- හීනවන ශේෂය	- குறைந்துசெல்லும் மீதி
Compound Interrest	- වැල් පොලිය	- கூட்டு வட்டி
No. of monthly units	- මාස ඒකක ගණන	- மாத அலகுகளின் எண்ணிக்கை
Instalment	- වාරිකය	- தவணை

Instructions to plan the lesson:

After reinforcing first learning outcome of competency level 5.1, to de velop subject concepts related to learning outcomes 2 and 3, following learning specimen is prepared with group activities and lecture-discus sion method.

Time: 40 minutes

Quality inputs:

- Copies of the activity sheet

Instructions to the teacher:

Approach:

- Lead a discussion presenting a problem such as "Find the interest to be paid at the end of the month for a loan worth of Rs.5,000 at 2% interest rate" and reminding students that similar problems were solved in previous calsses. Monthly interest can be calculated as $5000x\frac{2}{100}$ = Rs.100.
- Show that the interest can be calculated even for few months or years adopting this method.

Development of the lesson:

- Group the student so that each group consists of five students and provide a copy of part I of the ativity sheet to each group.
- Give instuctions for part I of the activity sheet as follows:
- "A man borrows Rs. 5,000 at 2% monthly interest under the con dition that the interest is calculated only for the balance amoun(t and to repay the loan in 5 monthly installments".
- Accordingly, direct students to fill the blanks in the activity sheet to find the total interest.

- Write down the inforation in the activity sheet- Part I and fill the blanks accordingly to the students' information.
- Explain the process of calculating the total interest. State that Calculation of interest for the payable balance amount is reduc ing balance method.
- Explain that according to part I, calculation of interest is difficult when the number of installments is large and distribute part II of the activity sheet among groups suggesting to learn another method for that.
- Provide following instructions after distributing part II.
- Stating that the first question is considered and the protion of loan amount (capital) pays in a month is

  $\frac{5000}{5} = Rs.1000$, discuss that since this amount is consid ered as a unit and the interest per unit which is Rs.1,000 is

  $1000 \times \frac{2}{100} = Rs.20$ direct students to fill the blanks.
- After defining a unit, ask students the monthly installment and the loan amount.
- Explaining that the interest for each month can be calculated by multiplying number of units of the month by the interest per unit, direct studnets to fill the blanks in part II of the activity sheet.
- Writing down it on the black board, while discussing with stu dents confirm that the total interest payable is euqal to that of the first method.
- State that to get the total interest, the total no. of monthly units has to be multiplied by the monthly interest $15 \times 20 = Rs.300$.
- Explain that the addition of monthly units is $5+4+3+2+1 = 15$. Accordingly, the number of monthly units within six months is $6+5+4+3+2+1 = 15$ and within 12 installement the number of monthly units is $12+11+10+9+8+7+6+5+4+3+2+1=78$ and emphasize that it is easy to get these easily by $\frac{n}{2}(n+1)$ and using the equation $\frac{n}{2}(a+l)$ that you leant in lesson arithmatic progression.

Activity sheet for the Students:

Part I

- Fill the blanks in the below table.

Installment	Amount Payable	Monthly interest for the balance amount	Interest
1	5000	$5000 \times \frac{2}{100}$	100
2	4000	$4000 \times \frac{\quad}{100}$	80
3	.....	$3000 \times \frac{\quad}{100}$	.....
4	.....	..... ×	.....
5	.....	..... ×	.....
		Total interest	.....

Part II

- Fill the blanks in the below table.

Installement	Amount Payable	Monthly Units	Interest per Monthly unit	Interest
1	5000	5	5 × 20	100
2	4000	4	4 ×	80
3	3000	3	3 ×	.....
4	.....	.....	..... ×	.....
5	.....	.....	..... ×	.....
	No. of monthly units		Total interest	.....

Assessment and Evaluation:

- Assessment criteria:
  - Show that, If the no. of installments is 'n' the number of months the interest payable months is equal to $\frac{n}{2}(n+1)$.
  - State that it is important to know how to calculate total interest based on the reducing balance method.
  - Calculate the loan amount and total interest based on reducing balance method.
- Direct students to do the exercises of the lesson 9th in the textbook.

For your attention...

Development of the lesson:

- Use an activity to divide the total of loan amount and total interest by number of installments to get the monthly installement.
- Adopt a suitable method to calculate monthly installment relevant to leasing.
- Adopt a suitable method to calculate the compound interest.

Assessment and Evaluation :

- Direct students to do the exercises of the lesson 9th in the textbook.

For further reference:

- http://www.youtube.com/watch?v=GtaoP0skPWc
- http://www.youtube.com/watch?v=t4zfIBwDhwM
- http://www.youtube.com/watch?v=qEB6y4DkINY

10. Share Market

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

Competency level 5.3 : Considers the share market in order to make investments

Number of periods: 05

Introduction

- Public limited company can join with large number of the inves tors in order to raise its capital.
- Limited companies raise its capital by issuing shares. A share is a unit of capital.
- Public limited companies can issue shares to the general public while private limited companies cannot issue shares in public.
- Only listed limited public companies can openly issue their shares to the general public.
- A listed company is limited public company that is registered in the share market.
- When buying and selling through the share market, the price assigned for a share by a company is known as the **market price of a share.** The investers can buy shares from the market price.
- Value of the shares is given by the market price of a share x number of shares and it is considered the **sum of investment** of a share holder joining the company and the **stated capital** of the company.
- The number of shares to which an investor is entitled is given by

$$\frac{\text{value of shares}}{\text{market price of a share}}$$

- Dividend for shares is decided by th annual profit of the company. It is stated as a certain sum per a share (e.g. Rs.5 per share from annual dividend).
- The advantage enjoyed by the investors who had bought shares for a greater selling price than the buying price is the 'capital profit'. eg: If a person having 500 shares of consideration Rs.12 sells each of them for Rs.15, his capital profit is (Rs.15-Rs.12) x 500.

Learning outcomes relevant to competency level 5.3 :

1. Accepts that many people can be involved in a business through the invest ment in shares
2. Accepts that limited companies supply their capital by issuing shares
3. Names the price of a share of an established company as the **consideration of the share**
4. **States that the consideration of shares (stated capital/invested funds) is ob tained by multiplying the consideration of a share by the number of shares**
5. **States that the number of shares that can be bought is obtained by dividing the invested funds (consideration of shares/stated capital) by the consider ation of a share**
6. **Calculates the dividend income that an investor receives by multiplying the dividend paid for a share by the number of shares**
7. Solves problems involving invested funds (consideration of shares/stated capital), consideration of a share and dividend paid for a share.

Glossary of terms:

Shares	-	කොටස්	-	பங்குகள்
Share Market	-	කොටස් වෙළෙඳ පොල	-	பங்குச் சந்தை
Capital	-	ප්‍රාග්ධනය	-	மூலதனம்
Market price	-	වෙළෙඳ පොල මිල	-	சந்தை விலை
Limited Companies	-	සීමාසහිත සමාගම්	-	வரையறுக்கப்பட்ட கம்பனி
Stated Capital	-	ප්‍රකාශිත ප්‍රාග්ධනය	-	கூட்டப்பட்ட மூலதனம்
Dividends	-	ලාභාංශය	-	பங்கிலாபம்
Investment	-	ආයෝජනය	-	முதலீடு
Value of shares	-	කොටස්වල වටිනාකම	-	பங்குகளின் பெறுமானம்
Capital profit	-	ප්‍රාග්ධන ලාභය	-	மூலதன இலாபம்

Instructions to plan the lesson:

A exemplar lesson plan based on the lecture-discussion method for developing learning outcomes 4,5 and 6 under the competency level 5.3 in students after establishing the first three learning outcomes under the same competency level is given below.

Time: 40 minutes

Quality inputs:

- A demy paper on which the problem in annex 1 is writtten

Instructions for the teacher:

Approach:

- Discuss with students that meaning of the technical terms consideration of a share, consideration of shares or stated capital, dividends and in come

Development of the lesson:

- Display to the class the demy paper with the problem.
- Discussing with students, write how the problem is solved on the board (Here pay attention to the answers given below).

a) (i) Rs.15 x 3,000
Rs.45,000

(ii) Rs.3 x 3,000
Rs.9,000

b) (i) Rs.$\frac{450000}{15}$
Rs.30000

(ii) Rs.3 x 30000
Rs.90000

c) (i) Rs.18 x 30000
Rs.540000

(ii) Rs.5 x 30000
Rs.150000

- Afterwards, assign the exercise prepared for them and let them write the answers
- After answering, check the correctness discussing with students.

Activity sheet for the students:

The consideration of a share issued by Amali company limited is Rs.20 and the divedend payed for a share is Rs.5. The consideration of shares of Deepal, a shareholder of this company is Rs.1,000,000. For a need of money Deepal sells his shares. At the time of selling it is announced that the consideration of a share is Rs.30 and the dividend payed for a share has increased by Rs.2.

(i) How many shares does Deepal have in the company?
(ii) How much Deepal will receive by selling his shares?
(iii) What is the capital profit of Deepal?
(iv) Find the dividend income of Suneth who bought shares owned by Deepal.

Assessment and Evaluation:

- Assessment criteria:
  - Obtains consideration of shares of a limited company by multiplying the consideration of a share by the number of shares.
  - Finds dividend income when the dividend of a share and the number of shares are given.
  - When two of stated capital, consideration of a share and the number of shares are given finds the third quantity.
  - Solves relevant problems when the consideration of a share and the dividend change
  - Involves in learning while activity taking part in the discussion
- Direct the students to the relevant exercises of the lesson 10th in the textbook.

For your attention...

Development of the lesson:

- Plan and implement lessons with students to establish subject con cepts related to learning outcome 7 of competency level 5.3 also as appropriate.

Assessment and Evaluation :

- Direct students to do the exercises of the lesson 10th in the textbook.

For further reference:

- https://www.cse.lk/

Annex 1

1. The consideration of a share issued by Dasatha Company limited is Rs.15. The dividend paid by this company for a share is Rs.3.

(a) Suneth bought 3000 shares of this company

(i) Find the consideration of shares bought by Suneth

(ii) Find the dividend income of Suneth in a year

(b) The stated capital of Anusha, another share holder of the above company is Rs.450000.

(i) Find the number of shares belonging to Anusha

(ii) Find the dividend income of Anusha

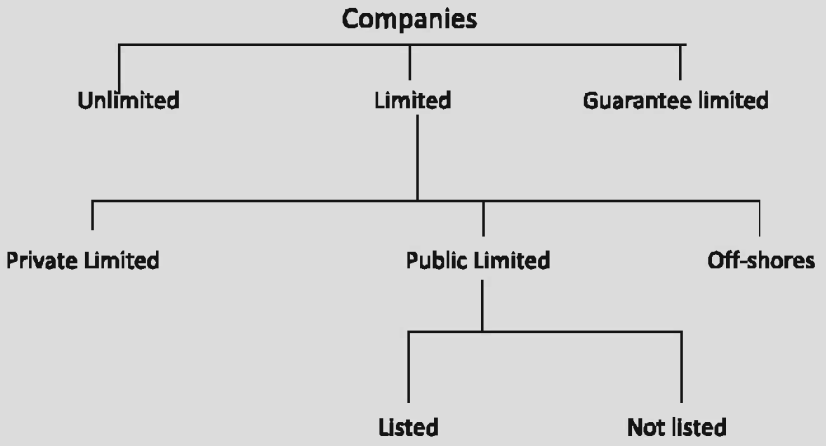
(c) Anusha has to sell her shares for a financial requirement. At this period the consideration of a share was Rs.18 and the dividend payable for a share was increased by Rs.2.

(i) What sum of money was spent by Amaya who bought Anusha's shares?

(ii) Find the dividend income of Amaya

For the teacher only:

- Companies can be classified accordance with the company regulation act 7 in 2007 as follows;



- When first half of the year 2015, there are 292 listed companies in the share market. Pre sentation of financial information of the company to those who became share holders by buying its shares is legal obligation.

11. Mid -point Theorum

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

Competency level 23.6: Investigates the results of dividing the sides of a triangle according to a ratio

Number of periods: 08

Introduction

In this lesson, another relationship among the sides of a triangle is discussed. The lesson aims to develop the abilities of recalling the mid-point theorum, its verification and formal proof, application of the theorum, and proving the riders. It is also expected to impart the skills of identifying the converse of the mid-point theorum and promote abilities to apply it and proove riders through the application of the converse.

Learning outcomes relevant to competency level 23.6:

1. **Separately names the straight line which joins the mid-points of two sides of a triangle and the third side.**
2. **Identifies the mid-point theorem.**
3. **Verifies the mid-point theorem.**
4. Performs calculations using the mid-point theorem.
5. Proves riders using the mid-point theorem.
6. Formally proves the mid-point theorem.
7. Identifies the converse of the mid-point theorem.
8. Performs calculations using the converse of the mid-point theorem.
9. Proves riders using the converse of the mid-point theorem

Glossary of terms:

Mid point	-	මධ්‍ය ලක්ෂ්‍යය	-	நடுப்புள்ளி
Converse	-	විලෝමය	-	மறுதலை

Instrutions to plan the lesson:

Given below is a specimen lesson plan with an individual activity within the group based on the guided-inquiry method. This aims to enable students to achieve the learning outcomes 1, 2, and 3 relevant to the competency level 23.6

Time: 40 minutes

Quality inputs:

- Required number of copies of the activity sheet
- Coloured A4 papers
- Pairs of scissors

Instructions for the teacher:

Approach:

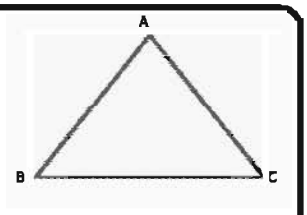
- Draw the figures of a rectangle and parallelogram on the board and discuss about their characteristics. State that the rectangle as a special case of the parallelogram and discuss about the features such as the opposite sides are equal and parallel.

Development of the lesson:

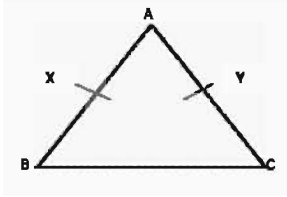
- Explain with diagrams the theorum 'the line joining the mid-points of two sides of a triangle is parallel to the third side and is euqal to half of the third side'.
- Direct the students to identify the two sides marked with mid-points and the third side
- Group the students appropirately to verify the mid-point theorum, distribute acitivity sheets, coloured A4 sheets and pairs of scissors to them and engage the students in the activity.
- After the students cut the trainagles, do the teacher demonstration of marking the mid-points
- After folding along XY as given in the activity sheet, go to the groups to see that the rectangle is made by brining the vertices B and C on point A.
- Show rectangle obtained and discuss about rectangles
- Through this, verify that $XY \parallel BC$ and $XY = \frac{1}{2}BC$.

Activity sheet for the Students:

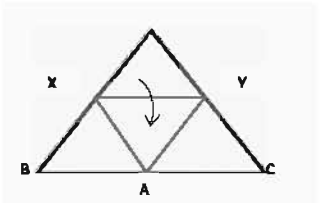
- Draw any triangle, name it ABC and get it cut



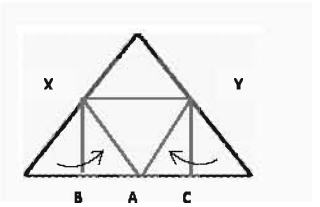
- Bring vertex A on B and get the point X. Then bring vertex A on C and get the point Y.



- Bring A onto BC as shown in the figure by folding along XY



- Take B upto A along BC and fold. Then take C upto A along CB and fold



- Discuss your observations with the rest of the group and record.

Assessment and Evaluation:

- Assessment criteria:
  - Identifies the mid-points of two sides of a triangle and the third side
  - States the mid-point theorem
  - Verifies the mid point theorum
  - Accepts that the line joining the mid points of two sides of a triangle is paral lel to the third side and that line exaclty half the third side
  - Formulates common statements through specific observations
- Direct the students to do the relevant exercises of the lesson 11th in the textbook

For your attention....

Development of the lesson:

- **Plan and implement appropriate strategies to establish subject concepts rel evant to learning outcomes 4 to 9 of competency level 23.6.**

Assessment and Evaluation:

- **Direct the students to do the relevant exercises of the lesson 11th in the textbook.**

For further reference:

- https://www.youtube.com/watch?v=ozb998JdcDI
- http://www.sknool.lk/content/ks3/maths/los/algebraic/index.html

12. Graphs

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

Competency Level 20.1: Solves problems using graphical methods

Competency Level 20.2 : Analyzes the properties of a quadratic function by considering its graph

Competency Level 20.3 : Analyzes the properties of a quadratic function by observing the function

Number of periods : 12

Introduction:

In the earlier grades students have learnt to draw the graphs of functions of the type y=mx, draw the graphs of functions of the type y=mx+c and $Y = ax^2 \pm b$ and specific features of those graphs. Since the functions such as y = mx+c given here takes the form of a linear binomial equation, graphs of y=mx+c type can be used to solve simultaneous equations. When the graphs of the pair of simulaneous equations are drawn on same coordinate of the point common to them gives the solution of those equations. The graphs of the functions of the type $Y = ax^2 + bx + c$ we study in this grade, take the shape of a parabola. Depending on $a<0$ *or* $a>0$, the turning point of the graphs would be a minimum or a maximum point. In a function of the type $Y = ax^2 + bx + c$, the roots of the equation $Y = ax^2 + bx + c$ obtained when y=0 can be ascertained by the graph. The roots of the equation given by the x coordinates of the points of intersection of x axis by the graph. The behaviour of the function can be discussed by identifying the part of the graph above the x axis as the part in which the value of the function becomes positive and the part below the x axis as the part in which the value of the function becomes negative. In order to discuss the behavious of the function like this, x cordinates of the points of inersection of x axis by the graph are made use of. When a quadratic function is given as $2y = \pm(ax \pm b)^2 + c$, the axis of symmentry of its graph is minimum/maximum value is given by c. So, the point of inflexionis given by $\left(\frac{\mp b}{a}, c\right)$. In the case of a graph of a function such as $y = \pm(x \pm a)(x \pm b)$, the points that intersect x axis are $(\mp a, 0)$ and $(\mp b, 0)$. The axis of symmetry of that graph is $x = \frac{(\mp a)+(\mp b)}{2}$

Learning outcomes relevant to competency level 20.2:

1. Calculates the y values corresponding to several given x values of a function of the form $y = ax^2 + bx + c$ when $a, b, c \in \mathbb{Q}$ and $a \neq 0$.
2. Draws the graph of a function of the form $y = ax^2 + bx + c$ for a given domain.
3. **Finds the maximum/minimum value, equation of the axis of symmetry and the coordinates of the turning point of a function of the form $y = ax^2 + bx + c$, using its graph.**
4. **By considering the graph of a function of the form $y = ax^2 + bx + c$, finds the roots of the equation $y = 0$.**
5. **Using the graph of a function of the form $y = ax^2 + bx + c$, finds the interval of values of x for which the function is negative or negative and decreasing or negative and increasing or positive or positive and increasing or positive and decreasing.**
6. **Using the graph of a function of the form $y = ax^2 + bx + c$, finds the values of x corresponding to a given value of the function.**
7. Using the graph of a function of the form $y = ax^2 + bx + c$, finds the interval of values of x corresponding to a given interval of values of the function.
8. Draw the graphs of the functions of the form $y = \pm (x \pm b)^2 + c$ and $y = \pm(x \pm a)(x \pm b)$ for a given domain.
9. Describes the properties of the functions of the form $y = \pm (x \pm b)^2 + c$ and $y = \pm(x \pm a)(x \pm b)$ by considering its graphs.

Glossary of terms:

Domain	-	වසම	-	ஆட்சி
Function	-	ශ්‍රිතය	-	சார்பு
Range	-	පරාසය/ප්‍රාන්තරය	-	வீச்சு / ஆயிடை
Maximum value	-	උපරිම අගය	-	உயர்வுப் பெறுமானம்
Minimum value	-	අවම අගය	-	இழிவுப் பெறுமானம
Turning point	-	හැරුම් ලක්ෂ්‍යය	-	திரும்பற் புள்ளி
Axis of symmetry	-	සමමිති අක්ෂය	-	சமச்சீர் அச்சு

Instruction to plan the lesson:

Presented here is a specimen lesson plan suitable for implementing under the inquiry method in groups to develop the learning outcomes 3,4,5 and 6 relevant to the competency level 20.2 in students after reinforcing the subject concepts relating to Learning outcomes 1 and 2 under the competency level 20.1 and 20.2

Time: 40 minutes

Quality inputs:

- Copies of the graphs in annex 1
- Copies of the activity sheet

Instructions for the teacher:

Approach:

- Using a sketch diagram explain as learnt in grade 10, that in a graph of a function of the type $y = ax^2 \pm b$, minimum/maximum value is b, axis of symmetry is x=0 and the point of inflexion is (0,b).

Development of the lesson:

- Divide the students into groups as appropirate and distribute the quality inputs.
- After the group activities are over lead a discussion based on the students' findings.
- During this discussion use the graph $y = ax^2 + bx + c$ to explain how the following area determined.
  - Maxima and minima
  - Axis of symmetry
  - Roots of y=0
  - Ranges of the value of x that make the value of the function positive or positively increasing or pisitively decreasing
  - Ranges of the value of x that make the value of the function negative or negatively increasing or negatively decreasing.
  - Values of x for the values of the given function

Acticity sheet for the students:

- Examine well the graph given by the teacher
- Using the graphs, complete the following table discussing within the groups.

Information / Graph	A $y=x^2+2x-3$	B $y=-x^2+x+6$
1. Axis of symmetry of the graph		
2. Coordinates of the turning point (point of inflexion)		
3. Minimum/Maximum value of the function		
4. Values of x when y=2 (using the graph)		
5. Coordinates of the points of intersection of x axis using the graph		
6. Values of x for y = 0		
7. Value range of x in graph A when the y coordinates are negative		
8. Value range of x in graph B when y coordinates are positive		
9. Value range of x in graph A when the value of y decreases negatively		
10. Value range of x in graph A when the value of y increases negatively		
11. Value range of x in graph B when the value of y increases positively		
12. Value range of x in graph B when the value of y decreases positively		

Assessment and Evaluation:

- Assessment criteria:
  - Examines the graph of a function of the type $y=ax^2\pm bx\pm c$ and states its minimum/maximum point, axis of symmetry and the point of inflexion.
  - Finds the roots of the quadratic equation $ax^2\pm bx\pm c=0$ using the graph of a function of the type $y=ax^2\pm bx\pm c$.
  - Writes the value ranges of x that makes the value of the function positive or negative using the graph of a function of the type $y=ax^2\pm bx\pm c$.

- Presents logically the facts leading to the conclusions
- Works cooperatively within the group.

- Direct students to write answers for the relevant exercises of the lesson 12th in the textbook and questions in the past O.L examiniation papers and discuss the answers.

For your attention...

Development of the lesson:

- Prepare lesson plans as appropriate for the sections of the subject relavant to learning outcomes 7,8 and 9 of competency level 20.2 and implement.
- Prepare lesson plans to achieve subject concepts relevant to competency level 20.2 as appropriate and implement.

Assessment and Evaluation:

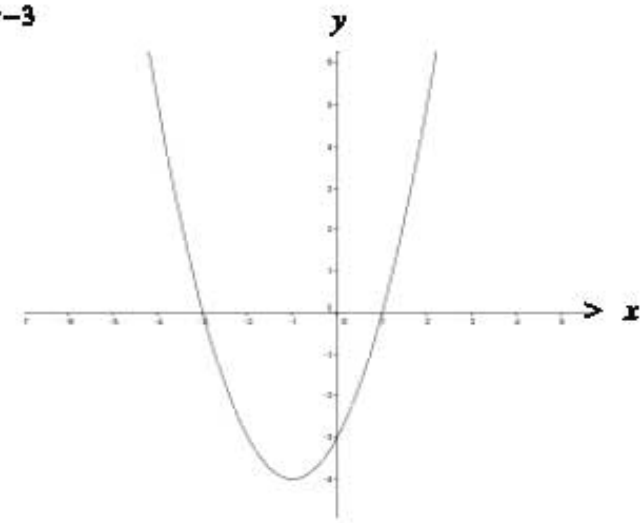
- Direct the students to do the relevant exercises of the lesson 12th in the textbook

For further reference:

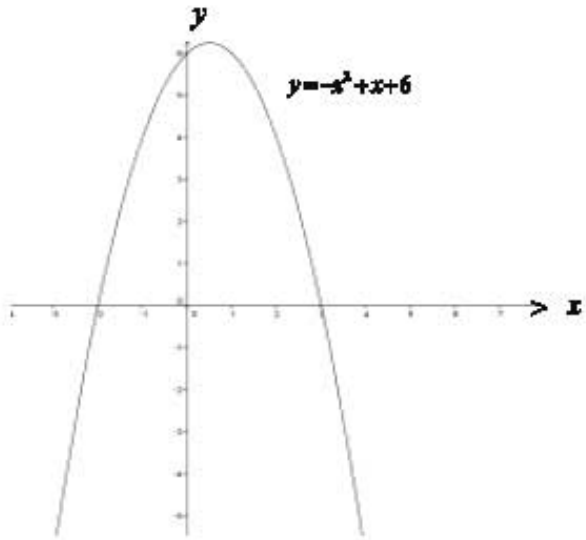
- http://www.youtube.com/watch?v=MRAlgImRmag
- http://www.youtube.com/watch?v=BNHLzEv6Mjg
- http://www.youtube.com/watch?v=3mImxluSVBo
- http://www.youtube.com/watch?v=CuPgmA7ytWA
- http://www.youtube.com/watch?v=RJkTEyO5Zso
- http://www.youtube.com/watch?v=eDv7dk9uNmM
- http://www.youtube.com/watch?v=uA6mcx4FMN8
- http://www.youtube.com/watch?v=99v51U3H5CU
- http://www.youtube.com/watch?v=Qv2pgv8aa-k
- http://www.youtube.com/watch?v=TgKBc3IgcLI
- http://www.youtube.com/watch?v=MQtsRYPx3v0
- http://www.youtube.com/watch?v=TgKBc3IgcLI
- http://www.youtube.com/watch?v=GHDrDdu6vrU
- http://www.youtube.com/watch?v=dfoXtodyIIA
- http://www.youtube.com/watch?v=IbI-I7mbKO4

Annex 1

$y=x^2+2x-3$



Graph A



Graph B

For the teacher only...

Equaling the differential cofficient of the function $y = ax^2 \pm bx \pm c$ to zero gives $2ax \pm b=0$. It is the axis of symmetry of the graph relevant to this function. As well as, x coordinate of the turning point is also gives from this.

13. Equations

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

Competency level 17.1: Uses simultaneous equations to solve problems

Competency level 17.2: Investigates how quadratic equations can be used to solve problems that arise in daily life

Number of periods: 05

Introduction:

In algebra, relationships among few variables can be represented as an equation. An equation with two unknowns cannot be simpli fied alone. But, when there is another simultaneous equation, values for two unknowns which matches with both equations can be found. These equations are called as simultaneous equations.

In this grade it is expected to simplify simultaneous equations with two constant unknowns and inequal rational coefficients and ex press given information in two simultaneous equations which has two unknown constants.

Simultaneous euqtions can be solved by equating coefficients of one unknown constant or by making one unknown constant the subject of an equation and substituting that expression to the other equa tion.

When an equation has only one unknown and a square value of it , that equation of the form $ax^2+bx+c(a\neq 0)$ is known as a quadratic equation. Quadratic equation has two answers. Answers for qua dratic equations can be obtained adopting different methods. Qua dratic equations can be solved using factors, completing square and following equation.

$$x=\frac{-b+\sqrt{b^2-4ac}}{2a}$$

The answers can be verified by substituting the answers to the qua dratic equation, it is possible to verify the answer and find informa tion of a given quadratic equation.

Learning outcomes relavant to competency level 17.2:

1. Finds the solution to a quadratic equation by using the factors of the trinomial quadratic expression in the quadratic equation.

2. **Solves a quadratic equation by completing the square.**

3. Solves a quadratic equation by using the formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

4. Verifies with reasons, the accuracy of the solution to a quadratic equation by substituting the obtained solution back into the equation.

5. Expresses the relationship in the given information by a quadratic equation.

6. Solves the constructed quadratic equation by using factors, by completing the square or by using the formula

Glossary of terms:

Unknown	-	අඥාතය	-	தெரியாக் கணியம்
Equation	-	සමීකරණය	-	சமன்பாடு
Simultaneous equation	-	සමගාමී සමීකරණය	-	ஒருங்கமை சமன்பாடு
Coeffient	-	සංගුණකය	-	குணகம்
Solution	-	විසඳුම	-	தீர்வு
Quadratic Equations	-	වර්ගජ සමීකරණය	-	இருபடிச் சமன்பாடுகள
Completing the Square	-	වර්ග පූර්ණය	-	வர்க்கப்பூர்த்தி

Instructions to plan the lesson:

The below a learning specimen prepared based on lecture discussion method, to achieve second learning outcome of 17.2, after achieving learning outcomes relevant to the competency level 17.1 and the first learning outcome of competency level 17.2.

Time: 40 minutes

Instructions for the teacher:

Approach:

- Explain that there are two answers for quadratic equations and the methodologies that can be applied when factors can not be used for that.
- Revise the on how to write a quadratic equation as a complete square.

Development of the lesson:

- Present a quadratic equation which canot not be solved using factors. Lead a discussion on how to solve it following below steps.

As an example $x^2-4x+1=0$

Step 1 ⟶ Check whether the given qudratic function can be solved by factoring.

Step 2 ⟶ Remove the constant to write the quadratic trinominal as a complete square

$$x^2-4x=-1$$

Step 3 ⟶ Add the term that has to be added to left side to make it a complete square.

$$x^2-4x+4=-1+4$$

Step 4 ⟶ Write the left hand side equation as a complete square.

$$(x-2)^2=3$$

Step 5 ⟶ Get the square root for both sides.

$$x-2=\pm\sqrt{3}$$

Step 6 ⟶ Using a calculator or any other method show that 1.732 as a new substitute .

$$x-2=\pm 1.732$$
$$x-2=1.732 \text{ or } x-2=-1.732$$
$$x=3.732 \text{ or } x=0.268$$

- Show that the quadratic equations that can be solved by factorising can also be solved from this method.
- Provide an opportunity to the students to solve another similar kind of quadratic equation.
- After getting the answers discuss with students and recall the steps adopted to solve a quadratic equation.

Assessment and Evaluation:

- Assessment criteria:
  - Select complete square method to solve a quadratic trinomial which cannot be factorised.
  - Adopt completing square method to solve quadratic trinomials which cannot be factorised.
  - Quadratic equations are solved using square method
  - Check the answers by substituting the answers to the quadratic equation.

- Apply alternative methods to solve problems.
- Direct students to do the exercises of the lesson 13th in the text book.

For your attention...

Development of the lesson:

- Plan and implement a suitable learning methodology to achieve learning outcomes 3,4,5 and 6 of competency level 17.2

Assessment and Evaluation:

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

For further reference:

- http://www.youtube.com/watch?v=OcNt-36QKu8
- http://www.youtube.com/watch?v=xCIHAJsZCE0
- http://www.youtube.com/watch?v=IPQ8cfOsYko
- http://www.youtube.com/watch?v=v6L8—MInKo
- http://www.youtube.com/watch?v=at4T4n4JYNc
- http://www.youtube.com/watch?v=2ZzuZvz33X0
- http://www.youtube.com/watch?v=04RpkdaNzr8
- http://www.youtube.com/watch?v=vl9o9XED0tw
- http://www.youtube.com/watch?v=55G8037gsKY
- http://www.youtube.com/watch?v=gzm-uhJ05q8
- http://www.youtube.com/watch?v=bNQY0z76M5A
- http://www.youtube.com/watch?v=95tChNVzodY
- http://www.youtube.com/watch?v=l7ldZf58t8w
- http://www.youtube.com/watch?v=lubx0z1lz8M

14. Equi-angled triangles

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

Competency Level 23.3 : Investigates the relationship between the sides of a triangle and parallelism

Competency Level 23.4 : Investigates the equi-angularity of two triangles

Number of periods : 12

Introduction:

Already Grade 11 students have identified a number of geometric relationships relevant to triangles. Different simplifications and proofs can be performed using the theorum "A line drawn parralel to one side of a trinagle divides other two sides proportionately" and its converse. When three angles of a trainagle equals to that of another triangle those are called equi-angled triangles and similar shape triangles are called as similar trinagles. In similar triangles, ratios of corresponding sides and corresponding angles are equal. But areas of those triangles are not always equal. Since equiangled traingles are similar traingles, corresponding sides of the trinagles are proportionate. Theorums relevant to these facts and application of those theorums are studied from this lesson.

Learning outcomes relevant to competency level 23.3:

1. **Identifies the theorem, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally".**
2. **Verifies the theorem, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally".**
3. **Performs calculations using the theorem, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally".**
4. Proves riders using the theorem, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally".
5. Identifies the converse of the theorem, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally".

6. Performs calculations using the converse of the theorem, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally".

7. Proves riders using the converse of the theorem, "The straight line drawn parallel to a side of a triangle cuts the other two sides proportionally".

Glossary of terms:

Proportional	- සමානුපාතිකව	- விகிதசமன்
Verification	- සත්‍යාපනය	- வாய்ப்புப் பார்த்தல்
Rider	- අනුමේය	- ஏறி
Proof	- සාධනය	- நிறுவல்

Instructions to plann the lesson:

Suitable learning specimens to acquire learning outcomes 1, 2 and 3 of competency level 23.3 is shown below. It can be implemented in groups.

Time: *40 minutes*

Quality inputs:

- A copy of students' instruction sheet and a diagram of a triangle drawn according to the measurements given below to each .
  Measurements of PQR Triangle:
  QR=12cm,PQ=15cm, PR=18cm
  'A' point on PQ so that QA=5cm

Instructions for the teacher:

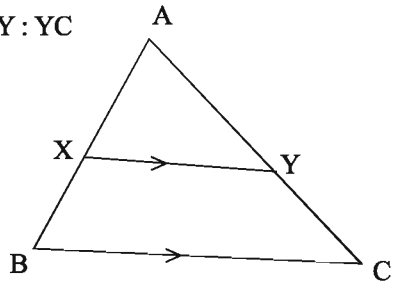
Approach:

- Inquiring the previous knowledge demonstrate on how to draw a straight line on given point and parallel to another line using pair of compasses.

Development of the lesson:

- Draw the below triangle on the board and explain the theorum; 'Straight line drawn parallel to one side of a triangle divide other two sides proportionately'.

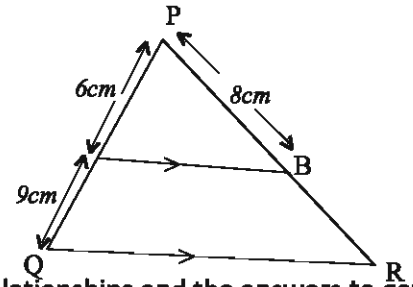
Therefore, AX : XB = AY : YC



- Group students and distribute instruction sheet and diagram of the triangle drawn according to the dimensions given under quality inputs
- After the students' activity inquire relationships and answers they got and discuss about the theorum and its applications.

Activity sheet for the Students:

- Draw a stright line parallel to QR through the point 'A' on PQ of PQR triangle. Name the point that meets the drawn line with PR as 'B'.
- Measure lengths of PA, AQ, PB, BR, line segments and obtain values for PA : AQ & PB : BR ratios.
- Discuss about the relationship among above ratios.
- Draw a line through point 'B' parallel to PQ and name the point that meets the QR as 'C'.
- Measure the lengths of required stright line segments and get the relationship for RB : BP & RC : CQ ratios.
- Find the length of BR applying previously identified relationships and the information in the below diagram.



- Be ready to present relationships and the answers to got.

Assessment and Evaluation:

- Assessment criteria:
  - Draw a parallel line to one side of a triangle.
  - Finds the ratios of line segments of two sides of a triangle divided by the line drawn parallel to one side of the triangle.
  - Accepts that the line drawn parallel to one side of a triangle divides the other two sides to an equal ratio.
  - Engage in calculations applying the theorum 'a line drawn parallel to one side divides the other sides proportionately'.
  - Work with the team corporatively.

- Provide exercise sheets to the students to do the calculation exercises applying proved theorums.
- Direct students to do the exercises of the lesson 14th in the textbook.
- Direct students to do the questions in previous Ordinary level question paper and questions in the text book.

For yor attention...

Development of the lesson:

- Plan and Implement lessons to achieve learning outcomes 4 and 5 of competency level 23.3
- Plan and Implement suitable methodology to reinforce learning outcomes relevant to competency level 23.4

Assessment and Evaluation:

- Direct students to the relevant exercises of the lesson 14th in the textbook.

For further reference:

- http://www.youtube.com/watch?v=Ly86lwq_2gc
- http://www.youtube.com/watch?v=EqNzr56h1Ic
- http://www.youtube.com/watch?v=9ThXDY9Y3oU
- http://www.youtube.com/watch?v=R-6CAr_zEEk
- http://www.youtube.com/watch?v=7aGEvpHaNU8
- http://www.youtube.com/watch?v=FVSgVMVZZ-4
- http://www.youtube.com/watch?v=VDnIdNM4tWI

15. Data Representation and interpretation

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

Competency Level 28.1 : Represents data graphically

Competency Level 28.2 : Develops connections between the graphical representations of date

Competency Level 28.3: Represents the relationship between the cumulative frequency of a group of data and the boundaries

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

Competency Level 29.1 : Uses quartiles and the interquartile range to interpret data represented by a Cumulative frequency curve.

Number of periods: 06

Introduction:

- Histogram, frequency polygon and cumulative frequency curve are methods used to represent data In a histogram.
- The area of the rectangle relevant to the respective class intervals is proportional to the frequency.
- When the class widths are equal, the height of the columns is equal to the frequency.
- When a frequnecy distribution with unequal class interval is given, the smallest class width should be taken into consideration and should find how many times is the interval as much as the smallest. The height of the column should be obtained by dividing the fre quency by that multiple.
- A frequency polygon can be drawn by joinng the mid-points of each column and the mid point of class interval left of the first column and mid point of the class interval right of the last column.
- The cumulative frequency can be obtained by adding the values in the frequency column in a frequency distribution either from top to bottom or from bottom to top.
- The graph drawn between the class intervals on the x axis and cumullative frequencies on the y axis is called the cumulative fre quency curve. A cumulative frequency curve is always signoid in shape.
- The medium can be obtained by reading the value in the cumulative frequency curve corresponding to the mid-value of the set of data.

Learning Outcomes relevant to competency level 28.1

1. Identifies the class limits and class boundaries of a frequency distribution.

2. Explains the difference between the class limits and class boundaries of a frequency distribution.

3. Finds the class limits and class boundaries of a frequency distribution.

4. Represents by a histogram, the information in a frequency distribution of continuous data in equal sized class intervals.

5. States that the area of each column of a histogram represents the corresponding frequency (f).

6. Finds the size of a class interval as a multiple of the size of the smallest class interval, for a frequency distribution in unequal class tervals, using $\frac{\textit{size of class interval}}{\textit{size of smallest class interval}} = n.$

7. When drawing a histogram for a frequency distribution in unequal class intervals, obtains the height of the column over a class interval using $\frac{f}{n}$.

8. Represents by a histogram, the information in a frequency distribution of continuous data in unequal sized class intervals.

9. Writes the relevant class boundaries of each class interval for a discrete frequency distribution.

10. Represents the information related to a discrete frequency distribution in a histogram

Glossary of terms:

Data	-	දත්ත	-	தரவு
Discrete data	-	විවික්ත දත්ත	-	பின்னகத்தரவு
Continuous data	-	සන්තතික දත්ත	-	தொடர்தரவு
Class interval	-	පන්ති ප්‍රාන්තර	-	வகுப்பாயிடை
Class limits	-	පන්ති සීමා	-	வகுப்பு எல்லை
Class boundaries	-	පන්ති මායිම්	-	வகுப்பு வரைப்பு
Class width	-	පන්තියක තරම	-	வகுப்பின் பருமன்
Frequency	-	සංඛ්‍යාතය	-	மீடிறன்
Histogram	-	ජාල රේඛය	-	வலையுரு வரையம்
Frequency polygon	-	සංඛ්‍යාත බහු අස්‍රය	-	மீடிறன் பல்கோணி
Mid value	-	මධ්‍ය අගය	-	நடுப்பெறுமானம்
Mid point	-	මධ්‍ය ලක්ෂ්‍යය	-	நடுப்புள்ளி
Cumulative frequency	-	සමුච්චිත සංඛ්‍යාතය	-	திரள் மீடிறன்
Cumulative frequency curve	-	සමුච්චිත සංඛ්‍යාත වක්‍රය	-	திரள் மீடிறன் வளையி

Instructions to plan the lesson:

A exemplar lesson plan adopting the lecture-discussion method and a group activity to develop learning outcome 4 in students following the development of learning outcomes 1,2 and 3 under competency level 28.1 is given below

Time: *40 minutes*

Quality inputs:

- A large poster depicting a frequency distributionwith equal class widths and a histo gram drawn for the same distribution.
- Graph papers (one for each group)
- Copies of the activity sheet

Instructions for the teacher:

Approach:

- State that by now the students have learnt various methods of representing data and histogram is another method that can be used to represent data. Display the poster to the calss.

Development of the lesson:

- Stating that the poster shows a histogram drawn for a frequency distribution of equal class width, discuss its features with the students.

- During the discusion highlight that,

-A histogram is drawn for data arranged in a continous manner; A histogram compirses columns and there are no spaces between the columns; Class inter vals should be marked on the x axis and frequencies should be marked on the y axis; and the area of each column drawn along x and y axes is proportional to the relevant frequency.

- Draw students' attention to the following facts that should be taken into con sideration before drawing a histogram.

(1) As the histogram is drawn only for continous data, one should see whether the given data area continous or discrete. If the data given are discrete class limits should be worked out(on this period, only continous data are considered).

(2) Should see whether the class widths are equal (In this period, only the cases with equal class widths are dealt with).

(3) Class intervals are marked on the x axis while frequencies are marked on the y axis.

- Divide the students into groups as appropirate, give each group a copy of the activity sheet and a graph paper and let the students to carry on with their task.

- After completing the task, let the groups show the histograms they have drawn to the class.

Activity sheet for the Students:

A frequency distribution prepared using the marks obtained for mathematics by a group of grade 10 students in a school with parallel classses at the first term test in a certain year is given below. The 0-20 class interval of it indicates the students' scoring 0 or above but less than 20.

	.....	.....	.....	.....	.....
Marks	0 - 20	0 - 40	40 - 60	60 - 80	80 - 100
Number of students (frequency)	6	18	48	22	16

(i) Find the class width of every class interval and write its value on the dotted line above the class interval with the pencil.
(ii) What can you say about the width of the five classes.
(iii) In which category of marks had most of the students scored?
(iv) Using the graph paper provided, draw the histogram for above information maring class intervals on the x axis and frequencies on the y axis
(v) Display the histogram drawn in front of the class.

Assessment and Evaluation:

- Assessment criteria:
  - Indentifies continous frequency distributions.
  - Finds the class widths of relevant class intervals.
  - Graduates x and y axes to draw the histogram.
  - Draws the histogram taking the class widths into consideration.
  - Uses figures for communication.
- Direct students to do the relevant exercises of the lesson 15th in the textbook

For your attention ...

Development of the lesson:

- This activity can be used to achieve the learning outcome 5.
- Plan a suitable method to develop the learning outcomes 6,7 and 8.
- Plan a suitable method to develop the learning outcomes 9 and 10 in stu dents using frequnecy distributions with discrete data
- Plan and implement suitable methods to enable sutdens to achieve sub ject concepts related to competency levels 28.2, 28.3 and 29.1

Assessment and Evaluation:

- Direct students to do the relevant exercises of the lesson 15th in the textbook

For further reference:

- http://www.youtube.com/watch?v=4eLJGG2Ad30

16. Geometric progressions

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

Competency level 2.1: Investigates the various behavioral patterns of number sequences which are progressions

Number of periods: 06

Introduction

When there is a common difference between successive terms of a number sequence it is called an arithmatic progression. When there is a common ratio between successive terms it is called as geometric progression. In a geometric progression, new term is obtained by multiplying the preceding term by a constant called the common ratio.

Further, if the first term of a geometric progression is 'a' and the common ratio is 'r', n^{th} term T_n, is given by $T_n=ar^{n-1}$ and the sum of first n terms S_n is given by $S_n = \frac{a(r^n-1)}{r-1}$ when r>1 and" $S_n = \frac{a(1-r^n)}{1-r}$ when r<1.

Learning outcomes relevant to competency level 2.1

1. Identifies number sequences of which the quotient between a term and the preceding term is a constant, as geometric progressions.
2. Selects the geometric progressions from a set of number sequences.
3. Determines the common ratio (*r*) of a geometric progression.
4. **Develops the formula $T_n = ar^{n-1}$ for the n^{th} term of a geometric progression with first term (*a*) and common ratio (*r*).**
5. For a geometric progression, finds the value of the fourth unknown term using the formula, when the values of three of the four unknowns *a*, *r*, *n* and T_n are given.
6. Finds the values of *a* and *r* using simultaneous equations when two terms of a geometric progression are given.

7. States that there are two progressions satisfying the given conditions, when two values are obtained for *'r'* when solving problems related to geometric progressions.

8. Develops the formulae $S_n = \frac{a(r^n - 1)}{r - 1}$, if $|r| > 1$ and $S_n = \frac{a(1 - r^n)}{1 - r}$ if $|r| < 1$, for the sum of the first *n* terms of a geometric progression with first term *a* and common ratio *r*.

9. Finds the sum of the first n terms of a geometric progression by selecting the relevant formula according to the value of $|r|$.

10. For a geometric progression, finds the fourth value using the formula, when the values of three of the four unknowns *a*, *r*, *n* and S_n are given (For $S_n < 20000$ only).

11. Solves problems related to geometric progressions (For $S_n < 20000$ only).

Glossary of terms:

Number Sequence	-	සංඛ්‍යා අනුක්‍රම	-	எண் தொடரி
Preceding Term	-	පසු පදය	-	முன் உறுப்பு
Succeding Term	-	පෙර පදය	-	பின் உறுப்பு
First Term	-	පළමු පදය	-	முதல் உறுப்பு
Common Ratio	-	පොදු අනුපාතය	-	பொது விகிதம்
Geometric Progression	-	ගුණෝත්තර ශ්‍රේඪී	-	பெருக்கல் விருத்தி

Instructions to plan the lesson:

After implementing a suitable learning strategy to establish subject concepts related to first, second and third learning outcomes of competency level 2.1, to develop concepts related to forth learning outcome, following learning specimen is prepared using guided inquiry method.

Time: 40 minutes

Quality inputs:

- Copies of the activity sheet

Instructions for the teacher:

Approach:

- Recall that geometric ratio is a number sequence in which the ratio between a term and the preceding term is a constant.

- Confirm this idea while discussing few examples for geometric pro gression such as 3, 6, 12, 24, ... and 27, 9, 3. 1, ...
- Discuss with examples that the common ratio of a geometric progression can be obtained by dividing a term by its preceding term.
- Remind that the n^{th} term in progressions is called T_n.

Development of the lesson:

- Group students, distribute activity sheets and engage the students in the activi ty.
- After completing the students' activity sheet, point out through the discussion that a new term can be found from the relationship among first term, common ratio and the number of the term.
- Point out through a discussion that when first term of a geometric progrsion is a and the common ratio is r, the n^{th} term is given by $T_n=ar^{n-1}$.
- Using this equation direct students to find the terms of other geometric progres sions.

Activity sheet for the Students:

- Look into the number sequence 3, 6, 12, 24,.....
- Find the first term and the common ratio of it.
- Complete the following incomplete table based on the above number sequence.

First term	T_1	3	3×2^0	$3\times2^{1-1}$
Second term	T_2	3×2	3×2^1	$3\times2^{2-1}$
Third term	T_3	$3\times2\times2$	3×2^2	$3\times2^{3-1}$
Forth term	T_4	$3\times2\times2\times2$	3×2^3	$3\times2^{4-1}$
Fifth term	T_5	.....	.....	.....
Sixth term	T_6	.....	.....	.....
⋮	⋮	⋮	⋮	⋮
Tenth term	T_{10}	.....	.....	.....
⋮	⋮	⋮	⋮	⋮
Twelfth term	T_{12}	.....	.....	.....
⋮	⋮	⋮	⋮	⋮
n^{th} term	T_n	.....	.....	.....

- Write down the formula for T_n if the first term and common ratio of a geomatric progression are 'a' and 'r' respectively.
- Present the completed table to the class.

Assessment and Evaluation:

- Assessment criteria
  - Presents examples for geomatric progressions.
  - Finds the common ratio of a given geometric progression.
  - Accepts that a new term in a geometric progression can be found with the help of the relationship among the first term, the common ratio and the number of the term.
  - Calculates a given term using the formula $T_n = ar^{n-1}$ when first term and the common ratio are given.
  - Works cooparatively within the group.
- Direct students to do the exercises of the lesson 16th in the text book.

Practical situations:

- discuss that the knowledge of geometric progression is used in find ing out the patterns related to the spread of diseases due to multi plication of germs and growths.

For your attention...

Development of the lesson:

- Plan and implement suitable activites to reinforce subject concepts relating to learning outcomes 5, 6, 7, 8, 9, 10, 11.

Assessment and Evaluation:

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

For further reference:

- http://www.youtube.com/watch?v=m5Tf6vgoJtQ
- http://www.youtube.com/watch?v=m5Tf6vgoJtQ

17 Pythagoras' Theorem

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

Competency level 23.5: Investigates the relationship between the sides of a right-angled triangle

Number of periods: 10

Introduction:

- In 6th century BC, a Greek mathematician called Pythagoras presented for the first time a relationship among the areas of squares drawn on the sides of right angled triangle. But there are evidences that Indian and Egyptian architects have worked according to this relationship. After about three hundred years, Euclid has methodically proved the relationship presented by Pythagoras, and included it in his book 'Elements' as a theorem.
- There are a number of proofs for Pythagoras' relationship and different methods to demonstrate it.
- Of them the most popular method is the Perigal's dissection.
- Pythagoras' relationship is widely used in architecture. Pythagorean triples are used in designing right triangles.
- Pythagoras relationship is used in calculations and to prove riders.

Learning outcomes related to competency level 23.5:

1. Names the hypotenuse and the sides which include the right angle in a right-angled triangle seperately.
2. Identifies Pythagoras' theorem.
3. Performs calculations using Pythagoras' theorem.
4. **Proves riders using Pythagoras' theorem.**
5. Inquires into the whole number pythagorean triples.

Glossary of terms :

Right-angled triangle - සෘජුකෝණී ත්‍රිකෝණ - செங்கோண முக்கோணி
Hypotenuse - කර්ණය - செம்பக்கம்
Pythagoras' theorem - පයිතගරස් ප්‍රමේයය - பைதகரசின் தேற்றம்
Pythagoras' triple - පයිතගරස් ත්‍රික - பைதகரசின் மும்மை

Instructions to plan the lesson:

A learning specimen designed adopting the lecture-discussion method is shown below to achieve learning outcome 4 of competency level 23.5 after achieving learning outcomes 1,2 and 3 relevant to competency level 23.5 in students.

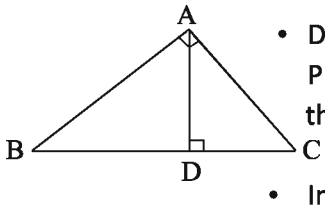
Time: 40 minutes

Instructions for the teacher:

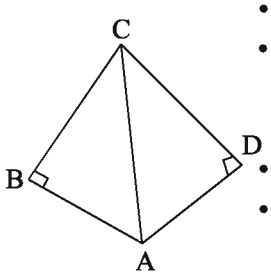
Approach:

- Draw and display the right-angled triangle ABC and start the discussion enquiring about the trainagle.
- Recollect students' knowledge pointing out the facts about right-angled tri angles, different sides including the hypotenuse and relationship among the sides according to the Pythagoras threorem.

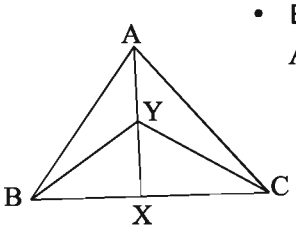
Development of the lesson:



- Draw this figure on the blackboard and pose the problem. Prove that $AB^2 - AC^2 = BD^2 - CD^2$ using the information given' to the students.
- Indicating that Pythogarous theorem can be used as regards the relationships required to be proved, ask the students about the number of right-angled triangles in the figure and the number of occasions for which Pythagoras theorem.
- Write the possible relationships among the sides according to Pythogorus theorem and name them ①,② and ③.
- State that those formulae can be combined as ①+②,①-②,②+③, ②-③ and discuss with students and select the suitable combination to prove $AB^2 - AC^2 = BD^2 - CD^2$.
- Writing down the necessary steps on the board complete the proof.



- Presenting the diagram discuss on proving $AB^2 + BC^2 = AD^2 + CD^2$ based on right-angled triangles and the number of opportunities applying pythogorous theorem.
- Develop the proof while discussion is continued.
- Direct students to prove the following in steps .



- Based on the information given in the diagram, prove that $AB^2 - AC^2 = BY^2 - CY^2$.

  1st step: Identifying right-angled triangles in the diagram

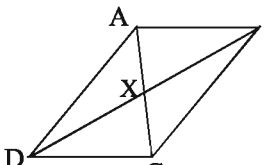
  2nd step: Deriving formulae for each right-angled triangle applying Pythagoras theorem.

  3rd step: Manipulating formalae in accordance with the fact to be proved.

  4th step: Writing down the steps in order.

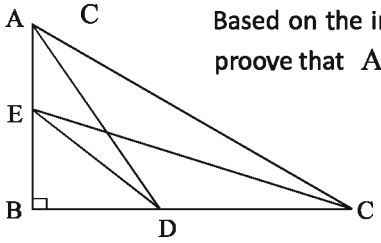
- Provide following to the students to prove individually.

(i)



Prove that $AC^2 + BD^2 = 4AB^2$ of the rhombuz ABCD.

(ii)



Based on the information in the diagram proove that $AB^2 - +CE^2 = AC^2 + EB^2$

Assessment and Evaluation:

- Assessment criteria:
  - Develops relationships relevant to the rider to be proved using the diagram.
  - Manipulates relationships in a way conducive to the proof.
  - Uses the only relationships required for the proof from the information pro vided.
  - Proves the riders using pythagaras theorum.
  - Presents the facts stepwise logically.
- Direct student to do the relevant exercises of the lesson 17th in the textbook.

Practical situations:

- Discuss that Pythagoras triples are applied in the field of construction to design right-angles and to get the measurements to inaccessible points in surveying.

For your attention...

Development of the lesson:

- Plan and implement a suitable learning-teaching method to reinforce subject concepts relevant to learning outcome 5 of the competency level 23.5.

Assessment and Evaluation:

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

For further reference:

- http://www.youtube.com/watch?v=ElNpkcphsPQ
- http://www.youtube.com/watch?v=1ul8g55dYA4
- http://www.youtube.com/watch?v=Lr55_J-gk94
- http://www.youtube.com/watch?v=TDlOrRETWhI
- http://www.youtube.com/watch?v=O64YFlX1_aI
- http://www.youtube.com/watch?v=nMhJLnSiVes
- http://www.youtube.com/watch?v=6EY0E3z-hsU

18. Trignometry

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

Competency level 13.1: Identifies the trignometric ratios of a right-angled triangle

Competency level 13.2: Manipulates trignometric relationships to fulfill daily requirements

Competency level 6.4: Uses the scientific calculator to solve mathematical problems including problems involving trigonometric ratios.

Number of periods: 12

Introduction:

- It is evident that trigonometric measurements had been used in ancient times for surveying in eastern countries such as China and India as well as in Greece and Egypt and countries such as middle east. This branch of mathematics is named "Trignometry" in Greek with the meaning triangle and measurement.

- Though the mathematical problems including relationship among the sides of a right-angled traingles can be solved by Pythagoras theorem it is not possible to use the same theorem to find the remaining sides and angles when an angle except right angle and a side is given. Trigonometry is used in such occasions.

- In a right-angled triangle, two sides which form the right angle are named opposite side and adjacent side in relation to the considered angle out of other two angles. Trignometric ratios have been developed as

  $\sin\theta$ = opposite side/hypotenuse, $\cos\theta$ = adjacent side/hypotenuse and $\tan\theta$ = opposite side/adjacent side when the angle is θ.

- In grade 11, trignometric ratios from 0^0 to 90^0 for θ only are considered.

- When the value of the θ increases from 0^0 to 90^0,
  value of $\sin\theta$ increases from 0 to 1.
  Value of $\cos\theta$ decreases from 1 to 0.
  Value of $\tan\theta$ increases from 0 to infinity.

- Using these ratios calculations related to right angled triangles are performed trignometric tables prepared with sin, cos and tan values for angles from 0 to 90^0 are used for these calculations .

- Problems involving angles of elevation and angles of depression and zenithals which are measurements of horizontal angles can be solved applying trignometric ratios.

- Answers for the mathematical problems solved applying trignometric ratios can be verified by the scientific calculator. Scinetific calculators have of special keys for trignometric ratios.

Learning outcomes relevant to competency level 13.1:

1. **Discovers that the sine value of an angle in a right angled triangle is given by the ratio of the length of the opposite side to the length of the hypotenuse.**

2. **Discovers that the cosine value of an angle in a right angled triangle is given by the ratio of the length of the adjacent side to the length of the hypotenuse.**

3. **Discovers that the tangent value of an angle in a right angled triangle is given by the ratio of the length of the opposite side to the length of the adjacent side.**

Glossary of terms:

Trignometry	-	ත්‍රිකෝණමිතිය	-	திரிகோண கணிதம்
Trignomitric ratio	-	ත්‍රිකෝණමිතික අනුපාත	-	திரிகோண கணித விகிதங்கள்
Opposite side	-	සම්මුඛ පාදය	-	எதிர் ப் பக் கம்
Adjacent side	-	බද්ධ පාදය	-	அயற்பக்கம்
Sine	-	සයිනය	-	சைன்
Cosine	-	කෝසයිනය	-	கோசைன
Tangent	-	ටැංජනය	-	தான்சன
Hypotenuse	-	කර්ණය	-	செம்பக்கம்

Instructions to plan the lesson:

A specimen lesson plan based on exploration and inquiry for developing subject concepts relevant to the learning outcomes 1, 2, and 3 under the competency level 13.1 is given below.

Time: *80 minutes*

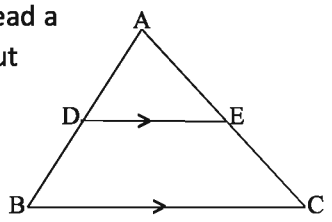
Quality inputs:

- Copies of the activity sheet

Instructions for the teacher:

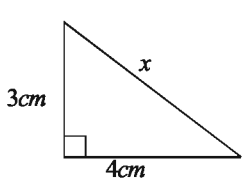
Approach:

- Displaying this diagram on the board, lead a discussion on triangles in it. Pointing out that triangles are similar and the corresponding sides are proportionate, write down those ratios on the board.

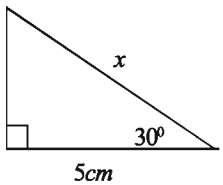


- Show that elements of the pair of equivalent fractions $\frac{2}{3}=\frac{4}{6}$ can be exchanged and written as $\frac{2}{4}=\frac{3}{6}$. Accordingly terms of above ratios can be written exchanging its terms as follows, so that it can be obtained from the same trainagle.

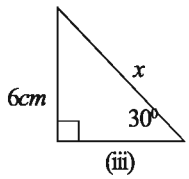
$$\frac{AD}{AB}=\frac{AE}{AC}\Rightarrow\frac{AD}{AE}=\frac{AB}{AC}$$



(i)



(ii)



(iii)

- Presenting above three diagrams, introduce opposite and adja cent sides using (ii) and (iii) and hypoculate.
- Direct students to find the value of x in (i). Encouraging students to find x of (ii) ‍ (iii) and since it is not possible to get an answer from the Pythagoras theorem direct students to the following explora tion to find a method for it.

Development of the lesson:

- Group the class appropriately for the following activity which leads to identify trigonometric ratios from a right-angled trainagle.
- Distribute copies of the activity sheet among students.
- After completing the activity, give an opportunity for the students to present the facts they have found about the trignometric ratios highlighting the following.
- Two sides which forms right angle in a right angled triangle are named either opposite side or adjacent side in relation to one of the two angles which is not the right angle.
- For a given angle in a right angled triangle trignometric ratios for opposite side/hytotenuse, adjacent side/hypotenuse, and opposite side/adjacent side are constants.
- When an angle is considered θ above ratios are called $\sin\theta$, $\cos\theta$ and $\tan\theta$
- In a right angled triangle, for an angle θ which is not the right angle.

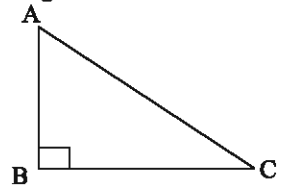
$$\sin\theta = \frac{Opposite\ side}{hypetenuse}$$

$$\cos\theta = \frac{Adjacentside}{hypetenuse} \quad , \quad \tan\theta = \frac{opposite\ side}{adjacent\ side}$$

Activity sheet for the students:

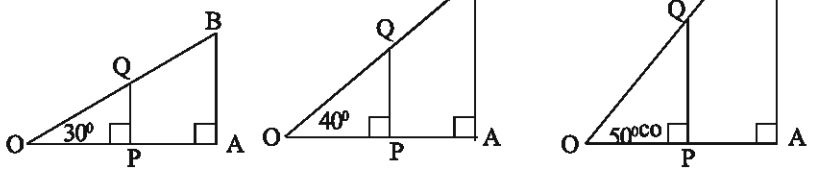
- Complete the following table after discussing and identifying the two sides, AB and BC as the opposite side or adjacent side, relative to an angle which is not the right angle, in the given right-angled triangle ABC in the activity sheet.

(i) Diagram



Angle	AB	BC
ACB $\angle$		
BAC $\angle$		

- (ii) Diagram



(a) (b) (c)

- Name the assigned two right angled triangles in the diagram. Discuss and discover that those triangles are similar triangles.
- Applying the theorem "Sides of similar triangles are proportionate" write down the relationship between sides of the above named right-angled traingles.
- Using the relationship $\frac{a}{b} = \frac{c}{d}$ when $\frac{a}{c} = \frac{b}{d}$ fill in the blanks in table 1, re placing the terms in with different sides of the same triangle.

table 1

$$\frac{PQ}{OQ} = \frac{\ldots\ldots}{\ldots\ldots}$$

$$\frac{OP}{OQ} = \frac{\ldots\ldots}{\ldots\ldots}$$

$$\frac{PQ}{OP} = \frac{\ldots\ldots}{\ldots\ldots}$$

- Complete the follwoing table 2 in relation to the diagram assigned to you.

table .2

	According to the angle $30^0/40^0/50^0$ of the right- angled triangle PQO	According to the angle $30^0/40^0/50^0$ of the right- angled triangle ABO
(i)	$\frac{\text{Opposite side}}{\text{Hypotenuse}}$ =	$\frac{\text{Opposite side}}{\text{Hypotenuse}}$ =
(ii)	$\frac{\text{Adjacent side}}{\text{Hypotenuse}}$ =	$\frac{\text{Adjacent side}}{\text{Hypotenuse}}$ =
(iii)	$\frac{\text{Opposite side}}{\text{Adjacent side}}$ =	$\frac{\text{Opposite side}}{\text{Adjacent side}}$ =

- Check whether the ratios of opposite side/hypotenuse, adjacent side/ hypotenuse, opposite side/adjacent side, corresponding to PQO and ABO trinagles in table 1 and 2 are equal or not.
- Find a suitable name for above ratios for a given angle of a right- angled triangle by referring the textbook or by any other method and fill the blanks in the btable below appropriately.

PQO right-angled triangle	ABO right-angled triangle
$\sin 30^0/40^0/50^0 = \frac{PQ}{\ldots\ldots}$	$\sin 30^0/40^0/50^0 = \frac{\ldots\ldots}{\ldots\ldots}$
$\cos\ldots\ldots = \frac{\ldots\ldots}{\ldots\ldots}$	$\cos\ldots\ldots = \frac{\ldots\ldots}{\ldots\ldots}$
$\tan\ldots\ldots = \frac{\ldots\ldots}{\ldots\ldots}$	$\tan\ldots\ldots = \frac{\ldots\ldots}{\ldots\ldots}$
$\sin 30^0/40^0/50^0 = \frac{\ldots\ldots}{\ldots\ldots}$	$\sin 30^0/40^0/50^0 = \frac{\ldots\ldots}{\ldots\ldots}$
$\cos\ldots\ldots = \frac{\ldots\ldots}{\ldots\ldots}$	$\cos\ldots\ldots = \frac{\ldots\ldots}{\ldots\ldots}$
$\tan\ldots\ldots = \frac{\ldots\ldots}{\ldots\ldots}$	$\tan\ldots\ldots = \frac{\ldots\ldots}{\ldots\ldots}$

- Present your finding to the whole class.

Assessment and Evaluation:

- Assessment criteria:
  - Identifies the opposite side and the djacent side of a right-angled triangle in relation to a given angle.
  - Writes the ratios between the sides corresponding to a given angle of two similar, right-angled triangles.
  - Accepts that ratios of the sides corresponding to a given angle of two similar, right-angled triangles are equal.
  - Compare ratios of sides corresponding to a given angle of two similar, right angled triangles.
  - Write down the ratios of sides of a right-angled triangle, corresponding to $\sin\theta$, $\cos\theta$ and $\tan\theta$ of a given angle θ.
- Direct students to write the trigonometric ratios for different right-angled triangles.

- Direct students to do the relevant exercises of the lesson 18th in the textbook.

Practical situations:

- Discuss with students that trignometry is used in aeronautic and naval engineering, building constructions and surveying.

For your attention.....

Development of the lesson:

- Plan and implement lessons appropriately for the competency level 13.2.

Assessment and Evaluation:

- Direct students to do the relevant exercises of the lesson 18th in the textbook
- Direct students to solve problems in past examiniation papers related to trignometry.

For further reference:

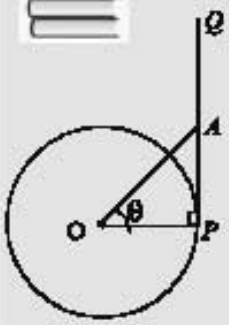
- http://www.youtube.com/watch?v=Jsly4TxgIME
- http://www.youtube.com/watch?v=I3jyBUyjg48
- http://www.youtube.com/watch?v=G-T_6hCdMQc
- http://www.youtube.com/watch?v=XbdMVHl8taQ
- http://www.youtube.com/watch?v=znR9tW4AIZI

For the teacher only.....

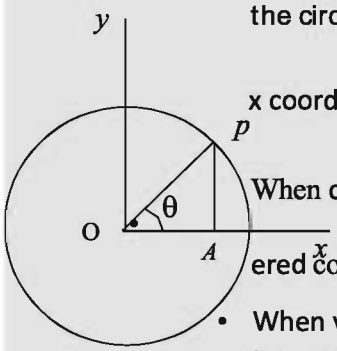
- It is effective to explain trigonometric ratios relative to a circle with a unit radius.

- The reason for this is that it shows clearly how the ration changes with the change in the angle.

PQ is the tangent drawn to point P on the circle with the centre O. The length of the tangent for an angle θ formed at the centre O is PA. It has to be divided by the radius to convert it to a unit radius.Then, $\tan\theta = \frac{PA}{OP}$



- If the orgin of the cartesian plane is 'O' the centre of a circle and the point on the circle for an angle θ is 'P' , coordinates y and coordinates x of 'P' are PA and OA respectively. When radius of the circle is 1 unit or OP=1, y coordinates = and x coordinates =



When coordinate *x* is considered sin and coordinate y is considered cos, $\sin\theta = \frac{PA}{OP}$, $\cos\theta = \frac{OA}{OP}$.

- When value of the angle increases, length of the tangent also increases so value of θ increases from 0 to 90^0 allowing tan to increase from 0 to infinity.
- when θ increases from 0 to 90^0, $\sin\theta$, increases from 0 to 1 and $\cos\theta$, decreases from 1 to 0.

19. Matrices

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

Competency level 20.4 : Manipulates matrices under the basic mathematical operations

Number of periods : 08

Introduction:

Matix is a method of arranging data in rows and columns. When the number of rows and columns are written combining with multiplication sign, it is called the order of the matrix. Order of the matrix is unique to that matrix and is written on the right hand side below the matrix. Matrices are classified as row matrices, column matrices and square matrices considering its order and as unit matrices and symmetric matrices according to position of its elements or its values. Two matrices can be added as well as substracted. But for that, the orders of the matrices should be equal. A matrix can be multiplied by an integer and when multiplying all the elements should be multiplied. Two matrices can be multiplied and for that, the number of columns of the first matrix should be equal to the number of rows of second matrix. That means (a x b) matrix and (b x c) matrices can be multiplied. Then the order of the resulting matrix is (a x c). If the positions of two matrices are changed, that is if (b x c) matrix is taken first and the (a x b) matrix taken next, the number of of columns of the first matrix is c and number of columns of the second matrix is a. Since the number of columns in two matrices are not equal, they cannot be multiplied. From this lesson, it is expected to learn these facts based on practical applications.

Learning outcomes relevant to competency level 20.4:

1. Identifies a matrix as a method of presenting information in rows and columns.
2. Recognizes that the order of a matrix is given by the number of rows and the number of columns of the matrix.
3. Recognizes row matrices, column matrices, square matrices, unit matrices and symmetric matrices.
4. Understands through practical situations that to add or subtract matrices, their orders should be equal.

5. Adds two row/column matrices of the same order, subtracts a row/ column matrix from a row/column matrix of the same order.

6. Adds and subtracts matrices of the same order up to matrices of order 3 x 3.

7. Gives reasons why two given matrices can/cannot be added or subtracted.

8. Multiplies a matrix of order up to 3 x 3 by an integer.

9. Simplifies matrices under the operations of addition, subtraction and multiplication by an integer.

10. Understands that to multiply two matrices, the number of columns of the first matrix should be equal to the number of rows of the second matrix.

11. Multiplies two matrices of order up to 2 x 2 .

12. Gives reasons why two given matrices can/cannot be multiplied.

13. Solves problems encountered in day to day life using the knowledge on matrices

Glossary of terms:

Matrix	- න්‍යාස	- தாயம்
Order of matrix	- න්‍යාසයේ ගණය	- தாயத்தின்வரிசை
Row matrix	- පේළි න්‍යාසය	- நிரைத் தாயம்
Column matrix	- තීර න්‍යාසය	- நிரல் தாயம்
Square matrix	- සමචතුරස්‍ර න්‍යාසය	- சதுரத் தாயம்
Unit matrix	- ඒකක න්‍යාසය	- அலகுத் தாயம்
Symmetric matrix	- සමමිතීය න්‍යාසය	- சமச்சீர்த் தாயம்
Elements of a matrix	-න්‍යාසයක අවයව	- தாயமொன்றின் மூலகங்கள்

Instructions to plan the lesson:

A suitable learning specimen to achieve learning outcomes 9, 10, 11, 12, 13 and 14 of competency level 20.4 through a group activity after reinforcing the subject concepts relating to the learning outcomes 1-8 is shown below.

Time: 40 minutes

Quality inputs:

- Copies of the acivity sheet

Instructions for the teacher :

Approach:

- Display this table on the blackboard which shows the number of apples and oranges bought by two persons 'A' and 'B' from a gro cery where the price of an apple is Rs. 50 and an orange is Rs.30.

Fruit	No. of apples	No. of oranges
A	2	3
B	1	4

- While discussing with students,
  - write down prices as a matrix of the orders (1 x 2) and (2 x 1).
  - write down the number of fruits bought by 'A' as a matrix form.
  - write down the number of fruits bought by both of them as a ma trix with order (2x2).
- Discuss that in order to calculate the amount spent by 'A' the num ber of fruits should be multiplied by prices of repective fruits.
- After the above discussion, group the students and engage them in the following activity.

Development of the lesson:

- After the student activity explain that,
  - to multiply two matrices, the number of columns of the first matrix should be equal to the number of rows in the second matrix;
  - two matrices can be multiplied by sequentially multiplying the elements of a row of the first matrix by elements of a column of the second matrix and adding up;
  - The order of the matrix obtained by multiplying a (2 x 2) order matrix by a (2 x 1) order matrix is (2 x 1) orders (2 x 1) and (2 x 1) gives a matrix of the order (1 x 1).
  - To confirm findings engage the students appropriately in exercises.

Activity sheet for the students:

- Items and their prices bought by Maheshi and Tharushi are shown below.

Price of a pencil = Rs.5

Price of an eraser = Rs.2

Items / Child	No. of Pencils	No. of erasers
Maheshi	3	4
Tharushi	5	1

- Write down the prices of items in a matrix of the order (2 x 1).
- Write down the qunatities bought by Maheshi as a (1x2) order matrix.
- Given below is how the amount spent by Maheshi is found by multiplying matrices.

$$\begin{pmatrix}3 & 4\end{pmatrix}_{1\times2}\begin{pmatrix}5\\2\end{pmatrix}_{2\times1} = \begin{pmatrix}23\end{pmatrix}_{1\times1}$$

- Discuss how the elements of two matrices are multiplied to get the total of Rs.23.
- Write down the matrices appropirately and find the amount spent by Tharushi.
- Find below how the amounts spent by Maheshi and Tharushi are calculated by multiplying a quantity matrix and a price matrix and shown by a in matrix of the order (2 x 1) .

$$\begin{pmatrix}3 & 4\\5 & 1\end{pmatrix}_{2\times2}\begin{pmatrix}5\\2\end{pmatrix}_{2\times1} = \begin{pmatrix}3\times5+4\times2\\5\times5+1\times2\end{pmatrix}_{2\times1} = \begin{pmatrix}23\\27\end{pmatrix}_{2\times1}$$

Carefully observe and discuss within the group, how the product of two matrices were obtained by multiplying the figures in rows and columns and adding the product.

- Applying above findings to multiply the matrices given below.

(i) $\begin{pmatrix}4 & 3\\5 & 2\end{pmatrix}_{2\times2}\times\begin{pmatrix}2\\3\end{pmatrix}_{2\times1}$ (ii) $\begin{pmatrix}5\\10\end{pmatrix}_{2\times1}\times\begin{pmatrix}2 & 3\end{pmatrix}_{1\times2}$ (iii) $\begin{pmatrix}\frac{1}{2} & 0\\4 & 3\end{pmatrix}_{2\times2}\times\begin{pmatrix}2 & 5\\1 & 0\end{pmatrix}_{2\times2}$

- $\begin{pmatrix}2\\3\end{pmatrix}_{2\times1}\begin{pmatrix}4 & 3\\5 & 2\end{pmatrix}_{2\times2}$ Is it possible to multiply these two matrices. What are the reasons for your answer?
- Discuss how the orders of matrices should be to multiply two matrices.
- Be ready to present group findings.

Assessment and Evaluation:

- Assessment criteria:
  - Multiplies two matrices with orders (1 x2) and (2 x1).
  - Accepts that the number of columns in the first matrix should be equal to the number of rows in the second matrix.
  - When multiplying two matrices, the solution is obtained by multiplying, elements in a row of the first matrix by the elements of a column in the second matrix sequentially and adding the products.
  - Multiplies two matrices of the order (2 x 2).
  - Presenting their own ideas. Engages in activities efficiently.
- Direct students to do the exercises of the lesson 19th in the text book.

Practical situations:

- Discuss with students the following instances where multiplication of matrices is used practically.
  - Matrices are used to simplify simultaneous equations.
  - Efficiency of stock taking process in shops is increased by reporting inforamtion in matrices.

For your attention...

Development of the lesson:

- Develop and implement a methodology to develop subject concepts relevant to the learning outcome 13 of the competency level 20.4.

Assessment and Evaluation:

- After this activity engage students in exercises appropriately. Prepare questions based on practical information and give to the students.
- Direct the students to do the relevant exercises of the lesson 19th in the textbook.

For further reference:

- http://www.youtube.com/watch?v=0oGiTQCy4cQ
- http://www.youtube.com/watch?v=WR9qCSXUlyY
- http://www.youtube.com/watch?v=TbaltFbJ3wE

For the for the teacher only:

- Find below the product of two (2x2) order matrices which present their elements in the algebraic form.

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix}_{2\times1} \times \begin{pmatrix} p & q \\ r & s \end{pmatrix}_{2\times2} = \begin{pmatrix} ap+br & aq+bs \\ cp+dr & cq+ds \end{pmatrix}_{2\times2}$$

- The square matrices in which all the elements in the main diagonal is 1 and other elements are zero, are known as unit matrices.

eg: $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}_{2\times2} \times \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}_{3\times3}$

- When A and B are square matrices and A x B gives a unit matrix B is the inverse of matrix A .

eg: $\begin{pmatrix} 7 & 3 \\ 2 & 1 \end{pmatrix}_{2\times2} \times \begin{pmatrix} 1 & -3 \\ -2 & 7 \end{pmatrix}_{2\times2} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}_{2\times2}$

$\begin{pmatrix} 1 & -3 \\ -2 & 7 \end{pmatrix}_{2\times2}$ is the inverse matrix of $\begin{pmatrix} 7 & 3 \\ 2 & 1 \end{pmatrix}_{2\times2}$

20. Inequalities

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

Competency Level 18.1: Solves problems that involve the relationships between two quantities

Number of periods: 06

Introduction:

- Inequality is combining two algebraic expressions of same variable and known magnitude, with an inequality mark.
- It is expected to solve inequalitities of the type $ax+b \lesseqgtr cx+d$ in this class.
- An answer for an unknown of an inequality can be obtained by making the unknown the subject of the equation.
- The answers so obtained can be represented on a number line.
- A matching solution for several inequalities can be obtained by simpli fying inequalities developed according to different relationships of the unknown.

Learning outcomes relevant to competency level 18.1

1. **Finds integral solution sets of the inequalities**

   $ax+b>cx+d, ax+b\geq cx+d, ax+b<cx+d, ax+b\leq cx+d$

2. Represents the integral solution sets of the inequalities

   $ax+b>cx+d, ax+b\geq cx+d, ax+b<cx+d, ax+b\leq cx+d$ on a number line.

3. Finds the intervals of solutions of the inequalities

   $ax+b>cx+d, ax+b\geq cx+d, ax+b<cx+d, ax+b\leq cx+d$

4. Represents the intervals of solutions of the inequalities

   $ax+b>cx+d, ax+b\geq cx+d, ax+b<cx+d, ax+b\leq cx+d$ on a number line.

5. Recognizes that inequalities of the form $ax+b \lesseqgtr cx+d$ can be used to represent certain applications of day to day life.

6. Uses inequalities of the form $ax+b \lesseqgtr cx+d$ to solve problems in day to day life

Glossary of terms:

Inequality	-	අසමානතා	-	சமனிலிகள
Solution set	-	විසඳුම් කුලකය	-	தீர்வுத் தொடை

Instructions to plan the lesson:

Given below is a learning specimen based on lectures and discussion method with teacher demonstration to develop subject concepts in students relevant to learning outcome 1 of competency level 18.1.

Time: *40 minutes*

Instructions for the teacher:

Approach:

- Write down an inequality such as $2x+1>7$ on the board and ask the students the steps to be taken to solve it.
- Considering the answers given by the students, discuss how to solve the above inequality step by step highlighting the following points.
  - Addition or subtraction of an equal positive number to or from both sides will not change the inequality.
  - Multiplication or division of both sides by the same positive number will not change the inequality.
  - Multiplication or division of both sides by the same negative number will change the inequality.

Development of the lesson:

- Write down an inequality such as $5x+1>3x+7$ on the black board and ask the speciality they observed in it.
- Explain that the speciality of this is having an unknown on both sides.
- Solves this inequality involving students with teacher demonstrations and get the answer $x>3$.
- Ask from the students the integer solutions for x.
- Explain that there would be unlimited number of solutions for x such as 4, 5, 6, 7, 8....
- Direct the students to solve an inequality such as $2x-7\leq 7x+3$.

- Do this as an individual activity.
- After the activity instruct a student to solve this inequality step by step on the blackboard.
- Explaining step by step confirm the answer.
- Stress that when this inequality is solved it is needed to divide it by a negative number and it will change the inequality sign.

Assessment and Evaluation:

- Assessment criteria:
  - Accepts that when solving an inequality of the form $ax+b \lesseqgtr cx+d$, division by a negative number is a requirement when it changes the sign of the inequality.
  - Describe the steps of solving an inequality of form $ax+b \lesseqgtr cx+d$
  - States that the solutions for a given inequality can be unlimited.
  - Solves a given inequality of the form $ax+b \lesseqgtr cx+d$
  - Writes the solution set of a given inequality of the form $ax+b \lesseqgtr cx+d$ in integers
- Direct the students to do the relevant exercises of the lesson 20th in the textbook.

For your attention...

Development of the lesson:

- Design and implement appropriate activities with teacher demonstrations in order to develop subject concepts relevant to learning outcomes from 2 to 6 under the competency level 18.1.

Assessment and Evaluation:

- Direct students to do the exercises of the lesson 20th in the text book.

For further reference:

- http://www.youtube.com/watch?v=y7QLay8wrWB
- http://www.youtube.com/watch?v=xOxvye5K0uA
- http://www.youtube.com/watch?v=X0An5z8mkvI
- http://www.youtube.com/watch?v=hJ-_OoCHTks
- http://www.youtube.com/watch?v=gIEP04Pzap8

21. Cyclic quadrilaterals

Competency 24 : Thinks logically to make decisions based on geometrical concepts related to circles

Competency Level 24.1: From among all quadrilaterals, investigates those that can be inscribed within a circle

Competency Level 24.2: Investigates the relationships between the exterior and interior angles of a cyclic quadrilateral

Number of periods: 10

Introduction:

When vertices of a quandragle lie on a single circle, the quandragle is called a cyclic quadrilateral. All rectangles and squares are cyclic quadrilateral whereas irregular quadrangle and trapezoids may be cyclic quadrilateral. "Opposite angles of a cyclic quadrilateral are summplementary" is a theorem relevant to angles of cyclic quadrilaterals. If opposite angles of a quandragle are supplementary vertices of the quandragle lie on a single circle. This is the converse of the above theorem. The external angle resulted by extending a side of a quandragle equals to internal opposite angle. This is a theorem relevant to the external angles of a cyclic quadrilateral. Above theorems and their connverses are discussed in this lesson.

Learning outcomes relavent to competency level 24.1:

1. **Writes down the pairs of opposite angles of a cyclic quadrilateral.**
2. **Identifies the theorem, "The opposite angles of a cyclic quadrilateral are supplementary".**
3. **Verifies the theorem, "The opposite angles of a cyclic quadrilateral are supplementary".**
4. Performs calculations using the theorem, "The opposite angles of a cyclic quadrilateral are supplementary".
5. Proves riders using the theorem, "The opposite angles of a cyclic quadrilateral are supplementary".
6. Formally proves the theorem, "The opposite angles of a cyclic quadrilateral are supplementary".
7. Identifies the theorem, "If a pair of opposite angles of a quadrilateral are supplementary, its vertices are con-cyclic".
8. Proves riders using the theorem, "If a pair of opposite angles of a quadrilateral are supplementary, its vertices are con-cyclic".

Glossary of terms:

Cyclic Quadrilateral	- වෘත්ත චතුරස්‍රය	- வட்டநாற்பக்கல்
Opposite angles	- සම්මුඛ කෝණය	- எதிர்க்கோணங்கள்
Supplementary	- පරිපූරක	- மிகைநிரப்பி
Exterior angle	- බාහිර කෝණය	- புறக்கோணம்
Riders	- අනුමේයන්	- ஏறிகள்
Interior opposite angle	- අභ්‍යන්තර සම්මුඛ කෝණය	- அகத்தெதிர்கோணம்

Instructions to plan the lesson:

Find below a learning specimen prepared as an individual group activity to develop subject concepts relevant to the learning outcomes 1, 2, and 3 of competency level 24.1 step by step under the guidance of the teacher.

Time: *40 minutes*

Quality inputs:

- Bristol boards, pastel, pairs of scissors, gum, rubber bands, circle board for teacher demonstration
- Copies of the activity sheet

Instructions for the teacher:

Approach:

- Remind students that they have learnt theorem related to the chord of a circle and angles of a circle.
- Remind the students about adjacent angles.

Development of the lesson:

- Present several cyclic quadrilaterals on the teacher demonstration circle board encircled by rubber bands.
- Asking qeustions make the students understand that all four vertices lie on the circle .
- State that such quadrangles are known as cyclic quadrilaterals.
- Draw a cyclic quadrilateral on the blackboard and name it ABCD.
- Asking opposite angles of each cyclic quadrilateral write down each pair of opposite angles.
- Present the theorem that opposite angles of a cyclic quadrilateral are summplementary.
- Distribute quality inputs and student activity sheets among students and engage them in the activity(Equipment in the mathematical laboratory relevant for this activity can also be used)

- After the activity, give an opportunity to students to present their findings.
- Discuss with students considering their presentations to confirm the theorem "Opposite angles of a cyclic quadrilateral are supplementary".
- State that this theorem can be proved formally and it will be discussed in a future lesson.

Activity sheet for the students:

- Read the activity sheet carefully and start the activity.
- Draw a circle with the radius of about 5 cm on a bristol board. (Each student in the group should individually engage in this activity).
- Draw a quadrilateral so that its vertices lie on this circle.
- Name a pair of opposite angles in the quadrilateral.
- Mark those angles with arcs and colour both angles in the same colour.
- Check whether the two coloured angles are supplementary (the sum is equal to 180^0) either by measuring them or examining the non-common sides after pasting them without overlapping adjuscently on a straight line.
- Check whether the other two opposite angles are also supple mentary.
- Present your findings to the class.

Assessment and Evaluation:

- Assessment criteria:
  - Identifies that the quadrilaterals whose all four vertices are mono cyclic are cyclic quadrilaterals.
  - Names opposite angles of a cyclic quadrilateral.
  - Proves that opposite angles of a cyclic quadrilateral are supplementary.
  - Presents requirements to be fulfilled by a circle to become a cyclic quadrilateral.
  - Successfully engages in the activity within the group.
- Direct students to do the exercises of the lesson 21st in the text book.

For yoyr attention...

Developmet of the lesson:

- Plan suitable methods to reinforce subject concepts relevant to learning outcomes 4, 5, 6 7 and 8 of competency level 24.1.
- Use equipments available in the mathematical laboratory or any other method to establish subject concepts relevant to compe tency level 24.2.

Assessment and Evaluation:

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

For further reference:

- https://www.youtube.com/watch?v=PV80HfP6Ai4
- https://www.youtube.com/watch?v=tVpe3HB1kQQ

22. Tangents

Competency 24: Thinks logically to make decisions based on geometrical concepts related to circles.

Competency level 24.3: Formally establishes the behavior of the angles related to tangents of circles.

Competency level 24.4: Investigates the properties of tangents drawn to a circle from a point outside the circle.

Competency level 24.5: Investigates the relationship between the angle between the tangent and a chord and the angle in the alternate segment.

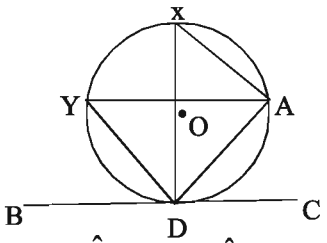
Number of periods: 10

Introduction:

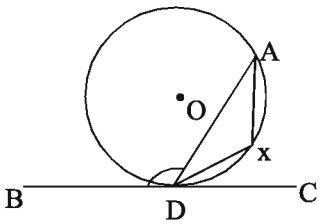
Only one tangent can be drawn through a given point on a circle. The per pendicular straight line drawn to the radius through the point is a tangent to the circle" is the first threorem identified in relation to tangents. Only two tangents can be drawn from an exterior point to a circle.

- When two tangents are drawn from an exterior point to a circle the two tangents are equal in length;
- angles subtended at the centre of the circle by tangents are equal.
- The straight line joining the centre of the circle and the exterior point bisects the angle between the tangents.

- According to the angle betwee the chord and the tangent considered, the other segment is the alternate segment.
- The angle of the segment is the angle subtended by the chord on the alternate segment of the circle.



In this $A\hat{X}D$ and $A\hat{Y}D$ are angles of the alternate segment in relation to $A\hat{D}C$



In this $A\hat{X}D$ is an angle in the alternate segment in relation to $A\hat{D}B$

- The angle between the tangent of a circle and the chord drawn to the point of contact is equal to the angle of the alternate segment.

Learning outcomes relevant to competency level 24.3:

1. Identifies the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle".
2. **Verifies the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle".**
3. Performs calculations using the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact is a tangent to the circle".
4. Proves riders using the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle".
5. Identifies the converse of the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle".
6. Verifies the converse of the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle".
7. Performs calculations using the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact, is a tangent to the circle".
8. Proves riders using the converse of the theorem, "The straight line drawn through a point on a circle and perpendicular to the radius through the point of contact is a tangent to the circle"

Glossary of terms:

Circle	- වෘත්තය	- வட்டம்
Radius	- අරය	- ஆரை
Tangent	- ස්පර්ශකය	- தொடலி
Perpendicular	- ලම්බකය	- செங்குத்து
Centre	- කේන්ද්‍රය	- மையம்
Exterior point	- බාහිර ලක්ෂ්‍යය	- வெளிப்புள்ளி
Segment of a circle	- වෘත්ත ඛණ්ඩය	- வட்டத்துண்டம்
Alternate segment of a circle	- ඒකාන්තර වෘත්ත ඛණ්ඩය	- ஒன்றுவிட்ட வட்டத்துண்டம்
Chord	- ජ්‍යාය	- நாண்
Subtended	- ආපාතිත	- எதிரமைக்கும்

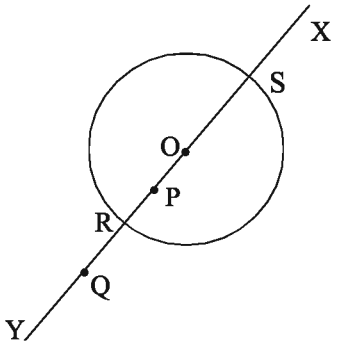
Instructions to plan the lesson:

Given below is a learning specimen based on group method for developing subject concepts relevant to the learning outcome 2 in students after the establishment of subject concepts relating to learning outcome 1 under the competency level 24.3.

Time: 40 minutes

Quality inputs:

- Compass, pencil, ruler
- Copies of an activity sheet
- Papers with the following diagram drawn(one per student))



Instructions for the teacher:

Approach:

- Inquire about the centre of circle, radius, chord, etc.
- Demonstrate how to draw a perpendicular line through a given point on a straight line while discussing.
- Enquire about the occations when a perpendicular is drawn to a line.
- Explain about the tangent using a diagram which depicts a tangent drawn to a circle.

Development of the lesson:

- Group the students as appropriate and provide half sheets with the diagrams and the activity sheets to the students.
- After the group activity give an opportunity to the students to present the results to the class.
- After the presentations provide an opportunity to write down the relevant theorem.
- After the discussion review what was learnt while proving theo rem.

Activity sheet for the students:

Theorem:
The straight line drawn through a point on a circle and perpen dicular to the radius through the point of contact, is a tangent to the circle.

- Considering following instructions engage the group in the activity relevant to the group.
- Construct perpendiculars to straight line XY, through the points P, Q, R, S on a given circle which has centre point 'O' and radius OR.
- Discuss within the group about the intersecting points on the circle by these perdendicular lines.
- Discuss which perpendicular lines intersect the circle only at one point.
- How do you identify lines OS and OR affliated to the circle.
- Suggest a special name based on the above threorem for the line drawn through one point of the circle and perpendicular to the radius.

Assessment and Evaluation:

- Assessment criteria:
  - States that the straight line drawn perpendicular to radius at the point of contact of the radius and the circle is tangent to the circle.
  - Identifies as tangents drawn to a circle, the intersects that meet a circle only at one point.
  - Construct a tangent to a circle at a given point on the circle.
  - Consolidates logically te principles with facts.
  - Works cooperatively within the group and completes the task.
- Direct students to do the relevant exercises of the lesson 22nd in the textbook.

For your attention...

Development of the lesson:

- Design and implement suitable activities to develop in students the subject concepts relevant to learning outcomes 3, 4, 5, 6, 7 and 8 under the competency level 24.3.
- Design and implement suitable activities to develop in students the subject concepts relating to competency levels 24.4 and 24.5.

Assessment and Evaluation:

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

For further reference:

- https://www.youtube.com/watch?v=CJNAO6LQmAw
- https://www.youtube.com/watch?v=k-tlMnL1xWc

23. Geometric constructions

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

Competency level 27.1: Constructs circles related to triangles

Competency level 27.2: Constructs tangents to a circle using the relationships between the angles related to tangents

Number of periods: 05

Introduction:

In this section construction of circles related to trinagles under competency level 27.1 and constructing tangents to a circle using relationships relevant to anlgles of tangents under competency level 27.2 will be discussed.

Ruler and pair of compasses and knowledge on loci are used for geometric constructions. Students have learnt in the previous grade to construct four primary paths, draw triangles, parallolegrams, trapezoids and constucting plane figures according to the given dimensions.

It is important to explain students that it will be easy to do a geometric construction according to the given data, adopting following steps.

1. Sketch a diagram according to the given data.
2. Mark the data in the sketch.
3. Identify geometric relationships.
4. Construct geometric diagram.

Learning outcomes related to competency level 27.2:

1. Constructs a tangent to a circle from a point on the circle.
2. Constructs tangents to a circle from an external point.
3. Verifies the properties of the theorems on tangents by using the above constructions.

Glossary of terms:

Point	ලක්ෂ්‍යය	-	புள்ளி
Locus	පථය	-	ஒழுக்கு
Circle	වෘත්තය	-	வட்டம்
Circumcircle	පරිවෘත්තය	-	சுற்றுவட்டம்

Inscribed circle	-	අන්තර්වෘත්තය	-	உள்வட்டம்
Outer circle	-	බහිර්වෘත්තය	-	வெளிவட்டம்
Tangent	-	ස්පර්ශකය	-	தொடலி

Instructions to develop the lesson:

A learning specimen with an individual activity implementable stepwise with teacher demonstrations, is shown below to develop subject concept relevant to learning outcomes 1 and 2 of competency level 27.2 after reinforcing learning outcomes relevant to competency level 27.1.

Time: *40 minutes*

Quality inputs:

- Pair of compasses and ruler

Instructions to the teacher:

Approach:

- Lead a brief discussion on equipments used in geometric constructions and how the use of the ruler and the pair of compasses.
- Demonstrate on the blackboard how to construct a perpendicular to a line at a given point.
- Demonstrate how to construct a perpendicular bisector to a line.

Development of the lesson:

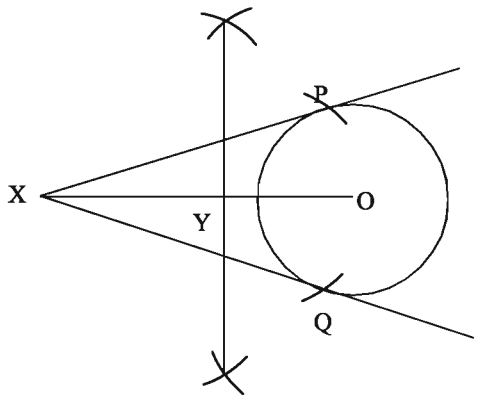
- Direct students to the geometric construction using teacher demonstrations (Teacher has to use the large pair of compasses and ruler correctly).
- 'X' is a point on the circle of which the centre is 'O'. Following the steps below, construct XY tangent to the circle that touches the circle at the point 'X'.

  Step 1- Draw a circle with centre 'O' and mark point 'X' on the circle.

  Step 2 - Draw the line OX and extend it upto the point P.

  Step 3 - Using the pair of compasses construct a perpendicular to line OXP at the point of X and mark it XY.
- Explain that radius OX of the circle and line XY are perpendicular to each other and therefore XY is a tangent drawn to the circle at the point X.

- Follow the following steps to develop skills of constructing tangents to a circle from an external point. Direct students to do the geometric constructions using teacher demonstrations.



- As shown in the diagram the centre of the circle is 'O' and the external point is 'X'.

  Step 1- Draw the circle with the centre 'O' and mark external point X. Draw the line OX.

  Step 2 - Using the pair of compasses construct perpendicular bi sector of OX. Mark the point 'Y' where OX and perpen dicular bisector intersect.

  Step 3 - Taking 'Y' as the centre point and YO as the radius draw arcs that intersect the circle at two cutting two points. Mark those two points P and Q.

  Step 4 - Draw lines XP and XQ. Explain students that XP and XQ are the tangents drawn to the circle.

Assessment and Evaluation:

- Assessment criteria
  - Uses the ruler and the pair of compasses correctly.
  - Constructs a tangent to a circle at a point on the circle.
  - Constructs a tangent to a circle from an external point to the circle.
  - Engages in geometric constructions according to the instructions given.
  - Completes the task systematically and with patience.
- Direct students to do the exercises of the lesson 23rd in the textbook.

For your attention:..

Development of the lesson:

- **Prepare specimens for the learning outcome 3 of competency level 27.2 and implement.**

Assessment and evaluation:

- **Direct students to do the relevant exercises of the lesson 23rd Inf the textbook.**

For further reference:

- **http://www.youtube.com/watch?v=KXZ6w91DIoU**
- **http://www.youtube.com/watch?v=VeJCw2NIE60**
- **http://www.youtube.com/watch?v=21vb8ICVIJE**
- **http://www.youtube.com/watch?v=x5c4oLA9e8o**

24. Sets

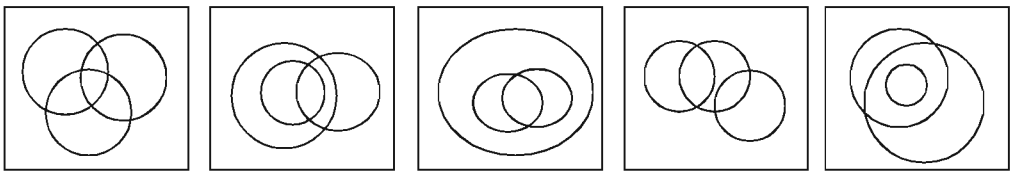
Competency 30: Manipulates the principles related to sets to facilitate daily activities

Competency Level 30.1: Uses Venn diagrams to solve problems related to sets

Number of periods: 06

Introduction:

- Different placements of thee sets in a Venn diagram is shown below.



- When describing different regions of a Venn diagram in words one should be mindful to use only on appropriate occasions.
- Care should be taken about intersection union and complement when repre senting sets as notations.

Learning outcomes relevant to competency level 30.1:

1. Draws the various ways of representing three sets in a Venn diagram.
2. **Describes in words the set which is denoted by a shaded region in a Venn diagram of three sets.**
3. Represents using set notations a set which is denoted by a shaded region in a Venn diagram of three sets.
4. Shades a region that has been described in words in a Venn diagram of three sets.
5. Shades a region that has been given in set notations, in a Venn diagram of three sets.
6. Using a Venn diagram, solves problems that can be represented using three sets.

Glossary of terms:

Set	-	කුලකය	-	தொடை
Element	-	අවයව	-	மூலகங்கள்
Set Notation	-	කුලක අංකනය	-	தொடைக்குறிப்பீடு
Venn Diagram	-	වෙන් රූපය	-	வென்உரு
Intersection of sets	-	කුලක ඡේදනය	-	இடைவெட்டுத்தொடை
Union of sets	-	කුලක මේලය	-	ஒன்றிப்புத் தொடை

Instructions to plan the lesson:

Find below the learning specimen prepared using group activities to achieve learning outcomes 2 after achieving the learning outcome 1 of competency level 30.1

Time: *80 minutes*

Quality inputs:
- Copies of the acitivity sheets,
- demy papers and marker pens.

Instructions for the teacher:

Approach:
- Draw a Venn diagram with intersetion of two sets and ask about its different regions from the students.
- Get the participation of students to find the set notation of those areas.
- Discuss with students on different ways of positioning three sets in a Venn diagram.

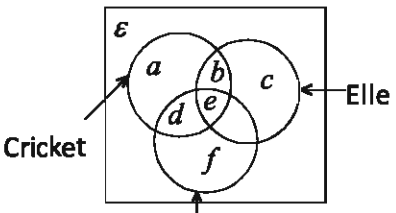
Development of the lesson:
- Group students appropriately as A, B and C, distribute copies of activity sheets among groups and engage them in the activity.
- Give opportunity to each group to present the completed activity sheets.
- After the presentations, review how areas of a Venn diagram with three sets are identified and described in words. Also discuss how the areas represented as a sum of two letters given in the activity sheet. (e.g. $a + b$) are described in words.

Activity sheet for the Students :

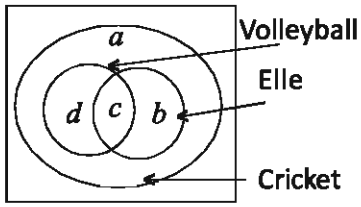
- Study the information given below and the venn diagram relevant to your group and complete the table given below.

- Find below, three Venn diagrams that depict the information relating to interest on Volley ball, Elle and Cricket of grade 11 students in three schools. English letters are used to differentiate the region in it.

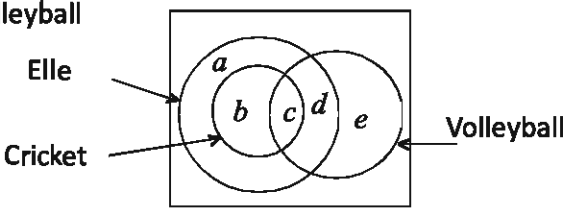
Group A



Group B



Group C



- Please a tick (✓) appropriately.

Letter (region)	likes Cricket	likes Volleyball	likes Elle
a	.....	.....	.....
b	✓	.....	✓
c	.....	.....	.....
d	.....	.....	.....
e	.....	.....	.....
f	.....	.....	.....

- Describe and write each region represented by a letter in words.
  Example: Those who like both cricket and elle.

a .....

b .....

c .....

d .....

e .....

f .....

- Give reasons for your answers
- Present to the class the facts you discovered from the Venn diagrm assigned to your group.

Assessment and Evaluation:

- Assessment criteria:
  - Identifies and names the regions in a Venn diagram consisting of three sets.
  - Describes the regions in a Venn diagram consisting of three sets in words.
  - Presents differences of the regions in a Venn diagram.
  - Accepts that different information can be presented in a Venn diagram.
  - Completes the task while cooperatively working within the group.
- Direct students to do the exercises of the lesson 24th in the textbook

.

For your attention...

Development of the lesson:

- Plan an appropriate activity to reinforce subject concepts relevant to the learning outcomes 3,4,5, and 6 of and implament.

Assessment and Evaluation:

- Direct students to do the relevant exercises of the lesson 24th in the text book.

For further reference:

- https://www.youtube.com/watch?v=iqaBt1_6PDA
- https://www.youtube.com/watch?v=0oo0r800sNM

25. Probability

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

Competency level 31.1: Interprets day to day events using various methods of representing the likelihood of occurrences.

Number of periods: 07

Introduction:

When two events are considered, if the occurrence or non-occurrence of one event does not affect the occurence or non-occurrence of the other event, such events are called independent events. The events which affect the occurrence of the other event are called dependent events. Sample frame of a random test that includes dependent events can be represented in a square grid and possible events of a random test that includes dependent events can be represented in a tree diagram. Problems related to dependent events can be solved using the tree diagram. Sum of probabilities of the events represented by branches of the tree diagram is 1. Sampling frame square grid can only show events which has equal likelihood and it is restricted only to two events. A tree diagram can show any equally probable as well as equally non-probable event and it is valid for any number of occurrences. In this grade, only two occasions are taken into consideration.

Learning outcomes related to competency level 31.1:

1. **Describes the nature of a dependent event.**
2. **Provides examples of dependent events.**
3. **Distinguishes and identifies dependent and independent events.**
4. **Represents the sample space of a random experiment involving dependent events on a grid.**
5. Writes down the probability of a given event using the representation on a grid of the sample space of a random experiment involving dependent events.
6. Solves problems involving dependent events using a grid.

7. Represents on a tree diagram, all the possible events of a random experiment involving 2 stages of dependent events.

8. States that the sum of all the probabilities on the branches of a tree diagram is 1 (one) for each stage.

9. Solves problems involving dependent events using a tree diagram.

Glossary of terms:

Random Experiment	-	සසම්භාවී පරීක්ෂණ	-	எழுமாற்று பரிசோதனை
LIndependent Event	-	ස්වායත්ත සිද්ධි	-	சாரா நிகழ்ச்சி
Dependent Event	-	පරායත්ත සිද්ධි	-	சார் நிகழ்ச்சி
Sample Space	-	නියැදි අවකාශය	-	மாதிரிவெளி
Square grid	-	කොටු ජාලය	-	சதுரக்கோட்டுச்சட்டம்
Tree diagram	-	රුක් සටහන	-	மரவரிப்படம்

Instructions to plan the lesson:

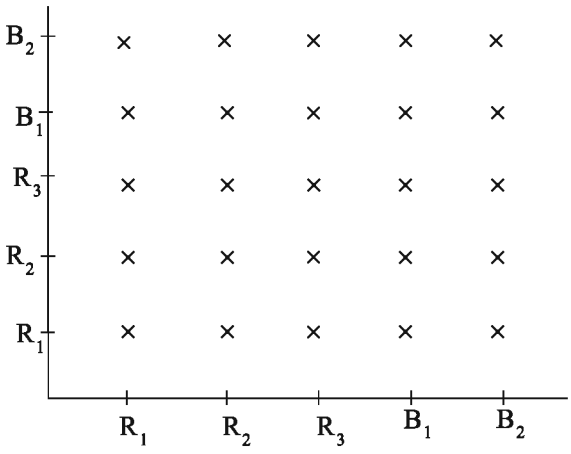
A learning specimen prepared including individual activities, lectures and discussions, to develop subject concepts under learning outcomes 1, 2, 3, and 4 of competency level 31.1, is shown below.

Time : *40 minutes*

Instructions for the teacher:

Approach:

- Stating that students have learnt in grade 10 how the sample space of an experiment in which a bead is randomly picked from a bag containing three idetical red beads and two blue beads (named R1, R2, R3, B1, B2), its colour is noted. returned to the bag and a second bead is taken is represented in a grid, display that grid drawn on a bristol board.



Approach the lesson posing following questions on the sample space to the students and eliciting answers.

1. Find the probability of both the bads being red.

2. Find the probability of the first bead is blue and the second bead is red.

Development of the lesson:

- Taking the example taken at the approach remind the students an occasion where the second bead is taken without replacing the first. Explain that the first bead was taken from six and the second bead was selected from five. State that since the first event affects the second event, it is called dependent event.
- Ask students that if the first selection was R1 whether it is possible to get R1 for the second time as well. Discuss students' answers and explain that it is impossible. In the same way, through the questions get the answer if R2 was drawn first, getting it for the second time is impossible.
- Provide oppourtunity for each student to note down the result of this activity in this exercise book.
- Instruct students to write elements of the sample space of this experiment as ordered pairs.
- Instruct students to represent that sample space in a square grid.
- Display on the blackboard a magnified version of the grid completed by the students.
- Get the students to compare the square grid used when approaching the lesson and the square grid drawn on the blackboard.
- Lead a discussion highlighting the differences of presenting dependent and independent events in a square grid.

Assesment and Evaluation:

- Assessment criteria:
  - Expalins what is an independent event.
  - Explains what is a dependent event.
  - Accepts that dependent events of a random test can be represented in a square grid.
  - Differentiates dependent and independent events from a group of events.
  - Displays the sample space of a random test imvolving dependent events on a square grid.
- Direct students to do the exercises of the lesson 25th in the textbook.

For your attention...

Development of the lesson:

- Plan a suitable methodology to achieve learning outcomes 5, 6, 7, 8, 9, of competency level 31.1 and implement.

Assessment and Evaluation:

- Direct students to do the exercises of the lesson 25th in the text book.

For further reference:

- http://www.youtube.com/watch?v=3_otNr9kRuY
- http://www.youtube.com/watch?v=O4Qnsubo2tg
- http://www.youtube.com/watch?v=RI874O5Jp1U
- http://www.youtube.com/watch?v=O4Qnsubo2tg
- http://www.youtube.com/watch?v=3ERBOkqBdpE
- http://www.youtube.com/watch?v=6E_NVnboMB8
- http://www.youtube.com/watch?v=wBDOCvHYckE