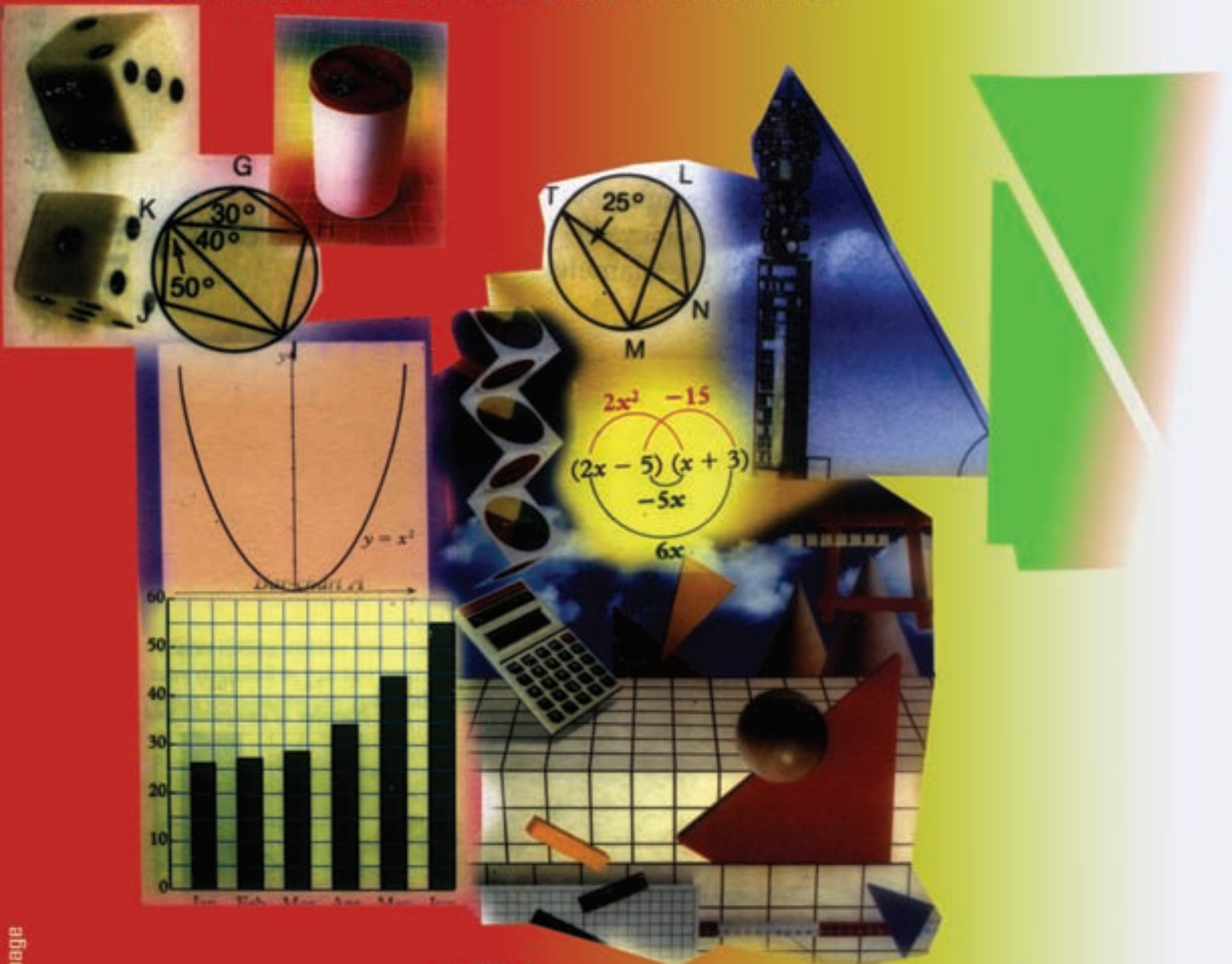


# MATHEMATICS

Grade

9

## Teacher's Instruction Manual

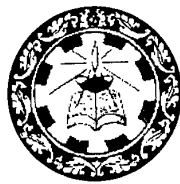


Department of Mathematics  
Faculty of Science & Technology  
National Institute of Education

# *Mathematics*

## GRADE 9 Teacher's Instruction Manual

**(Implementation in 2010)**



**Department of Mathematics  
Faculty of Science and Technology  
National Institute of Education**

# **Mathematics**

## **Grade 9 – Teacher’s Instruction Manual**

**© National Institute of Education  
First Print 2009**

**ISBN**

**Department of Mathematics  
Faculty of Science and Technology  
National Institute of Education**

**Website: [www.nie.lk](http://www.nie.lk)**

**Print:**

## Message of the Director General

While new approaches to the teaching of subjects in Junior Secondary and Senior Secondary Grades have been introduced by the National Institute of Education for Grade 9 in 2010, the present Teacher's Instructional Manual will provide excellent guidance to teachers on the teaching approaches they should adopt in teaching subjects. A significant change has been effected in the classroom Learning – Teaching activity through these teaching approaches introduced with respect to Grades 6 and 10 in 2007, Grades 7 and 11 in 2008 and Grade 8 in 2009.

This Teacher's Instructional Manual is provided to you in order to provide you with guidance on how you should organize your classroom activities so that they are student-centered. The organization of the classroom Learning – Teaching process based on the student-centered approach is not a new experience to either the Sri Lankan classroom or to the teacher. Nevertheless, the student-centered Learning-Teaching Methodology has been provided a novel character through this new approach.

Not only does the present Teacher's Instructional Manual provide the direction necessary in planning lessons to ensure student participation but it also judiciously builds up the environment required for the purpose. The activities in this Teacher's Instructional Manual have been so organized as to provide directions to students on the setting up of new groups for each lesson, exploring new information and generating new knowledge.

The basis of the guidance inherent in the Teacher's Instructional Manual is the philosophy that the teacher should be rather a Transformer of Knowledge than a mere Transmitter of Knowledge. As such, the activities here help transform the student into a learner who seeks knowledge and thereby generates new knowledge. Therefore, teachers are expected to direct and stimulate students to discover new knowledge through exploration.

It is believed that the underlying philosophy as well as the activities described in this Teacher's Instructional Manual will stimulate the teacher to break away from the shackles of traditional teaching methodologies and think. It is necessary that our teachers focus on new approaches and teaching methods. The new millennium has seen the birth and creation of an immense range of new knowledge. Therefore, there is need to break away from traditional methods and concentrate on planning new activities of one's own.

What is expected through the information included in a Teacher's Instructional Manual of this nature is to direct the teacher to higher approaches while providing him/her with the basic instructions that he/she could employ in his/her teaching tasks. It is expected that teachers will make a study of this Teacher's Instructional Manual with that objective in view and utilize the know how in the classroom. As such, what is mainly expected through an endeavour of this nature is to raise the efficiency and quality of the classroom Learning-Teaching process.

I would like to thank the subject specialists of the National Institute of Education as well as the external resource persons who contributed of their time and expertise in the preparation of this Teacher's Instructional Manual.

***Professor Lal Perera***  
*Director General*  
*National Institute of Education*

## Forward

The first curriculum reform of the new millennium has now completed two years of implementation. The curriculum material developed for grades 6, 7, 8 of the Junior Secondary Cycle (JSC) and grades 10, 11 of the Senior Secondary Cycle (SSC) are now in the system. At a time where one half of the introductory phase of the curriculum reforms sees its completion, it is very important for us to reflect on our past experiences, learn from them, and pave the way for the new thinking to contribute to sustainable development of the country.

This curriculum reform allows us to break away from a reactive approach to curriculum development to take up a proactive approach. Retaining the known, learning the pre-determined and constructing what is – emphasized over the past will be replaced by revising the known, exploring the undetermined and constructing what might be. To realize this new vision, we have adopted a competency-based, student-centered and an activity-oriented approach to curriculum development under the new transformational role of the teacher.

The teacher who directs students to construct knowledge and meaning in the learning-teaching process attempts to produce a person with an integrated personality. For this, the teacher takes the responsibility for developing thinking, social and personal skills of every child in the classroom. In view of bringing about a new society that can make correct decisions, solve problems and manage conflict, the teacher provides opportunity for the children to think in novel ways, derive meaning from their day to day experiences, engage in analytical thinking, and use both inductive and deductive logic to develop their logical thinking skills.

The new role proposed for the teacher also provides opportunity to develop social skills in students. The children exploring in groups will develop empathetic listening skills with abilities to care for others and share with others. The knowledge explosion we experience today does not allow anyone of us to depend on a teacher anymore to get at all the knowledge we need to be successful in life. Sharing knowledge both in small groups and with the whole class prepares the children to face challenges of the future. Getting different groups to explore different facets of the same problem and share their exploration findings with the larger group enables complex problems of tomorrow to be solved easily, and in a shorter period of time. This strategy also allows the children to consider their peer group as a learning resource and begin to learn from it while they are young. Instead of listening to the teacher the whole time, the children in the new reform will read, discuss, observe, engage directly in relevant tasks, and reflect to find out for themselves. To activate every member of the small groups, the teacher assigns work to them and refrains from appointing a leader. Children in such a context will use their hidden abilities to achieve the common objective set out for them. All students of a class thus using their knowledge to enrich one another and making optimum use of the opportunities available in the learning environment to listen, speak, read and write will develop their communication skills as well.

It is the responsibility of the teacher to get all members of different groups to participate actively in the exploration planned for them. For the success of this exploration, the teachers have to use their personalities to the maximum. As a first step here they identify a suitable way to group the students, use students with prior knowledge to support other students, direct students to share responsibility to make team presentations, discourage

reading out from pre-prepared answer scripts to facilitate innovative presentations, and remind students of the need to complete their work on time. In organizing for the presentations, the teacher gets the children to display their work before the class and draws the attention of everybody in the classroom to the findings presented. At the end of each presentation, the teacher requests the members of the presenting group as well as the members of the other groups to submit their constructive comments. The children take this opportunity to elaborate their findings. They clarify what is not clear and vague to them, correct what is incorrect, and fill whatever gaps they have identified in the findings. All this allows a number of student skills neglected in the past to be awakened and the schools to bring about a future generation who will not get isolated in the society.

The new methodology that comes to the fore in the new millennium helps children to develop their personal skills that originate from within themselves. The children working in groups learn to be patient with others. They control their temper by paying due respect to the opinions of others. They manage stress by prioritization, thriving for high quality products, saving time for self-development by avoiding gossip and improving planning skills. In addition to initiating new things and supporting productive changes initiated by others, the children begin to develop entrepreneurial skills through improved self-awareness and ability to take planned risks. The new methodologies provide ample opportunity for the children to be responsible and accountable as well. The teacher who directs the learning-teaching process to make all of the above tasks fruitful, not only contributes to the development of a new generation that is self-disciplined and committed for national development, but also begins to derive high satisfaction from his/her profession.

The activities to be implemented by the teacher in the new millennium, give an important place to assessment and evaluation. Assessment is the task in which the teachers involve themselves during the full time devoted for student explorations. Close observation of students at work, identifying where the students are, and taking necessary action to take them to the desired destination are the three main stages of the assessment process. The teacher provides feedback to those students with inabilities and weaknesses and feed forward to others with abilities and strengths to lead every child in the classroom from the darkness to the light. There is no doubt that evaluations conducted under adequate assessment give rise to excellent results. The teacher who assesses the children when they explore turns to evaluate them when they begin to explain and elaborate. The teachers completing evaluation also should not forget to announce the proficiency levels attained by their students to reinforce the learning they have accomplished.

Assessment and evaluation are conducted both within the activities and also on the basis of activity clusters. The latter considered as the second stage of school-based evaluation provides opportunity to the teacher to extend her teaching as well as the learning of her students beyond the timetable. The teacher is expected to use the learning-teaching-evaluation tools recommended in Part III of the Teacher's Instructional Manual (TIM) together with the 5E Model to be successful in this task. To make optimum use of this opportunity made available for extended learning and teaching, all teachers should meet small groups exploring outside the timetable at least once a week to investigate the outputs they have achieved, and to support them to solve their problems.

To avoid being a burden to the teacher, action has already been taken to reduce the number of evaluations to be conducted per term. The subjects with over three periods a week will have four evaluations per term while this would be three for subjects with three periods a week, and two for others with less than three periods a week. Out of the total number of

evaluations recommended per term, the last would be the term test. This is the only evaluation for which a written test is given. The teachers have to make use of the tools provided in the Teacher's Instructional Manual to complete the required number of school-based evaluations. To encourage learning outside the timetable, a compulsory question will be prepared for each term test covering the learning accomplished by the tools recommended. All this will provide opportunity for the students to involve in meaningful learning either independently or in small groups beyond the timetable.

There is no doubt that the activity continuum and the learning-teaching-evaluation tools developed thus and incorporated in Sections II and II of the Teacher's Instructional Manual will facilitate the new role of the teacher by bringing learning, teaching, assessment and evaluation to the same platform. Yet we should not forget that the teachers always have the freedom to adapt the material given to suit the size and nature of their classes or go for new material of their own to achieve the desired learning outcomes.

The examinations play a big role in realizing any developmental change proposed in the learning-teaching process. Understanding this situation, the Department of Examinations has decided to make a noticeable change in its question papers. A decision has been taken to step away from the predictable questions of what? why? when? where? who and how to introduce authentic evaluations developed on the basis of real life situations for both the term tests and the GCE (OL) examination. We hope that this action taken by the National Institute of Education to produce a new type of student who learns for life will replace the previous type of student who crammed for the examination and forgot everything in a short while. It is our sincere belief that this new thinking will draw the attention, acceptance and active participation of everybody who is committed to national development.

Deshamanya Dr. Indira Lilamani Ginige  
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# Message of the Commissioner General of Educational Publications



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# *Descriptive Syllabus*

## Introduction

The practices of life which should be nurtured in students studying mathematics from grade 6 to grade 11, by developing their skills, talents, values and social experiences have been identified as a set of competencies and organized to suit each grade. It is expected that students who study mathematics up to grade 11 will actualize all these competencies by the end of grade 11. To guide students towards achieving this goal, relevant competency levels as well as learning outcomes have been prepared.

The competencies which students who learn mathematics in grade 9 should aim at actualizing, the corresponding competency levels and the learning outcomes necessary to achieve this are included in this manual. The subject content, teaching sequence and the periods required to implement the learning, teaching, assessment and evaluation process which is based on the subject content and which will aid to guide students towards actualizing these learning outcomes are also included here. The competency based syllabi prepared for the subject Mathematics, which were implemented in grade 6 and grade 10 in 2007, in grade 7 and grade 11 in 2008 and in grade 8 in 2009, are presently operational. A policy decision has been made to operate it in grade 9 from 2010.

The subject content of this syllabus has been organized so that the following aims of learning mathematics are achieved.

- Knowledge and Skills
- Communication
- Identifying Relationships
- Reasoning
- Problem Solving

In implementing the learning, teaching, assessment and evaluation process through this competency based syllabus

- by providing opportunities for meaningful discovery, learning can be made more student centered
- guidance is provided for students to actualize the various competencies appropriate for their mental level and to develop these throughout their lives.
- since it is possible to identify how far each student has progressed towards each competency level, it is easy for the teacher to provide the required feedback and feed-forward.
- the opportunity is given for students to develop the necessary mathematical concepts as well as the principles related to them.
- the teacher is able to step away from traditional teaching methods and enter into a transformation role.

When operating this mathematics syllabus in the classroom, new teaching strategies should be developed by associating the various phenomena that appear under each topic with the needs of the region.

The activity plan introduced in grades 6, 7, 8, 10 and 11 can be implemented in the same manner in grade 9 too. But in writing the activity plans, the sections that recur repeatedly have been removed and only the instructions for group exploration, the facts that should be discussed and highlighted during the introduction and the plenary review, and the assessment and evaluation criteria, which are essential for each activity, have been included. In addition, the list of quality inputs which are needed in general for the activity continuum have been included at the end of the activity continuum, but, the special learning aids required for each activity have been included within the activity itself.

Students should be motivated towards exploration by using the introduction to each activity given in Step 1 or by some other appropriate method. The relevant subject matter which should be highlighted is also provided in Step 1. Engage the students in exploration by either using the leaflet on exploration which has been provided in Step 2 or some other aid. Exploration should be carried out either individually or in groups.

In Step 3, the subject facts which the teacher should highlight after the student's presentations of their discoveries are stated. The appropriate assessment and evaluation criteria are given at the end of the activity plan.

It would be more effective if this grade 9 mathematics syllabus is implemented after the problems that were identified in providing experience to the students through the mathematics syllabi of grades 6, 7, 8, 10 and 11 are resolved. Several such problems that were identified as well as appropriate activities which could be carried out as alternative solutions are included in this syllabus in the section titled 'School policies and programmes'.

In the learning – teaching – exploring process, since the opportunity to develop activities for each competency level is provided, assessment of the competency level which the student is approaching as well as evaluation is facilitated.

In addition, the following aspects

- the aims of learning mathematics
- competency based descriptive syllabus
- proposed teaching sequence and number of periods
- the school policies and programmes

which aid in carrying out the various duties related to teaching mathematics in schools are also presented in this syllabus.

## 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 senior secondary stage, so that their mathematical thinking, understanding and abilities are enhanced.

- (1) The development of computational skills through the provision of mathematical concepts and principles as well as the knowledge of mathematical operations, and the development of the basic skills of solving mathematical problems with better 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 relationships 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 arguments.
- (5) The development of the ability to use mathematical knowledge and techniques to formulate and solve problems both familiar and unfamiliar that arise in day to day life.

### 1. Knowledge and Skills

It is expected that students will acquire basic skills and gain understanding of concepts, principles and methods by learning mathematics. These can be used as tools to apply mathematical thinking in other fields, and also as a base for further mathematical activities. It is necessary to keep in mind the recent developments in technology when deciding on the skills and knowledge that the students should gain by memorizing or learning, as scientific calculators and symbolic processes which are affordable, more powerful and mechanical have an influence on senior secondary schools.

### 2. Communication

Due to the fact that mathematics has the power to communicate and represent ideas concisely and with clarity, the use of it in other disciplines has increased tremendously. Guaranteeing that students come to a common agreement regarding concepts and definitions should be an important component of the school curriculum.

This can be accomplished by providing students with the latitude to explain their ideas both orally and in writing, to think intuitively, and to defend their ideas. Through such activities, the skills of exchanging knowledge and working with amity in co-operation with others are guaranteed. These are considered as higher skills in the modern world of work.

### **3. Relationships**

Students are often inclined to think of mathematics as a series of isolated and unrelated truths and processes. It is therefore important to educate them about the many relationships that exist even in the learning of mathematics through graphical, numerical, physical and algebraic representations or models. Students should recognize that mathematical thinking and modeling are used to solve problems in other fields such as the Biological, Physical and Social Sciences, Arts, Music and Commerce, as well as in day to day life. They should also understand the manner in which mathematics has been related to our culture both local and foreign, in the past as well as in the present.

### **4. Reasoning**

The argument that has existed for years to pay greater attention to mathematics in the school curriculum is due to the belief that by learning mathematics, students will be able to develop clear and logical thought.

Although the principles of logic form the base for deductive reasoning in mathematics, there are many developments in mathematics based on induction, i.e., on conjectures that are proved by deductive reasoning, by first identifying patterns. The development of mathematics has occurred through the interactions that take place between various observations, identification of patterns, making assumptions and proving theorems. Students should be educated regarding these various aspects of mathematical thought and should also develop the skills related to each of them.

### **5. Problem Solving**

For a student to become a productive citizen it is essential that he/she develops problem solving skills. Problem solving is a common investigative path through which students develop an awareness of the usefulness and power of mathematics. Students will face various issues when they attempt to use logical and creative thought to analyze a mathematical method by which a wrong conclusion has been arrived at. But in every situation, the students have the ability to solve problems that are within the scope of the knowledge they have gained. Suitable methods should be developed to evaluate and appreciate the success of these efforts by students and these evaluation methods should be incorporated into the regular evaluation scheme.

### Competencies, Competency Levels and Subject Content

Competencies and Competency Levels	Subject Content	Periods
<p><b>Competency 1</b> Manipulates the mathematical operations in the set of real numbers to fulfill the needs of day to day life.</p> <p>1.1 Organizes numbers in ways that they can be manipulated easily.</p> <p>1.2 Determines approximate values to facilitate manipulation.</p>	<ul style="list-style-type: none"> <li>• Scientific Notation               <ul style="list-style-type: none"> <li>• Large Numbers (Up to a million)</li> <li>• Decimal Numbers</li> </ul> </li> <li>• Rounding Off               <ul style="list-style-type: none"> <li>• Whole Numbers (Up to a million)                   <ul style="list-style-type: none"> <li>• To the nearest 10</li> <li>• To the nearest 100</li> <li>• To the nearest 1000</li> </ul> </li> </ul> </li> <li>• Decimal Numbers (To a given decimal place)</li> </ul>	05
<p><b>Competency 2</b> Makes decisions for future requirements by investigating the various relationships in number patterns.</p> <p>2.1 Constructs the general term by observing the relationship between the terms of the number pattern.</p>	<ul style="list-style-type: none"> <li>• Number Patterns               <ul style="list-style-type: none"> <li>• General Term</li> </ul> </li> </ul>	05
<p><b>Competency 3</b> Manipulates units and parts of units under the mathematical operations to easily fulfill the requirements of day to day life.</p> <p>3.1 Methodically simplifies Expressions with fractions.</p>	<ul style="list-style-type: none"> <li>• Simplifying Fractions               <ul style="list-style-type: none"> <li>• Including brackets, 'of'</li> <li>• BODMAS</li> </ul> </li> </ul>	06



Competencies and Competency Levels	Subject Content	Periods
<p><b>Competency 4</b> Uses ratios to facilitate day to day activities.</p> <p>4.1 Engages in calculations by considering direct proportions.</p>	<ul style="list-style-type: none"> <li>• Direct Proportion               <ul style="list-style-type: none"> <li>• Unitary Method</li> <li>• Foreign Currency</li> </ul> </li> </ul>	04
<p><b>Competency 5</b> Makes successful transactions in the modern world by using percentages.</p> <p>5.1 Makes decisions by comparing profits and losses.</p> <p>5.2 Makes decisions by calculating the interest.</p>	<ul style="list-style-type: none"> <li>• Profit, Loss</li> <li>• Uses of Percentages (Discounts, Commissions)</li> <li>• Simple Interest               <ul style="list-style-type: none"> <li>• Interest Rate</li> <li>• Monthly</li> <li>• Annual</li> </ul> </li> <li>• Calculating the Interest               <ul style="list-style-type: none"> <li>• For the Amount</li> <li>• For the Period</li> </ul> </li> </ul>	11
<p><b>Competency 6</b> Easily solves mathematical problems in day to day life by using logarithms and calculators.</p> <p>6.1 Simplifies powers by applying the laws of indices.</p>	<ul style="list-style-type: none"> <li>• Indices               <ul style="list-style-type: none"> <li>• Zero Index</li> <li>• Negative Indices</li> <li>• Laws of Indices                   <ul style="list-style-type: none"> <li>• Multiplication</li> <li>• Division</li> <li>• Power of a Power</li> </ul> </li> </ul> </li> </ul>	12

Competencies and Competency Levels	Subject Content	Periods
<p>6.2 Develops the relationship between indices and logarithms and writes powers as logarithms and logarithms as powers.</p> <p>6.3 Uses calculators to facilitate calculations.</p> <p><b>Competency 7</b> Carries out daily tasks effectively by investigating the various methods of finding the perimeter.</p> <p>7.1 Develops the relationship between the diameter and the circumference of a circle.</p>	<ul style="list-style-type: none"> <li>• Writing as Logarithms                             <ul style="list-style-type: none"> <li>• Expressions with Indices</li> </ul> </li> <li>• Logarithms <math>\Leftrightarrow</math> Powers</li>   <li>• Use of the Keys of a Calculator                             <ul style="list-style-type: none"> <li>• =, %</li> <li>• <math>x^2, \sqrt{x}</math></li> </ul> </li>   <li>• Circle                             <ul style="list-style-type: none"> <li>• Measuring the Diameter</li> <li>• Measuring the Circumference</li> <li>• Relationship between the Circumference and the Diameter</li> <li>• Use of Formulae</li> </ul> </li> </ul>	<p>05</p>
<p><b>Competency 8</b> Makes use of a limited space in an optimal manner by investigating the area.</p> <p>8.1 Investigates the area of simple geometrical shapes in the environment.</p> <p>8.2 Investigates the shapes of the surfaces of solids in the environment and determines their area.</p>	<ul style="list-style-type: none"> <li>• Area of Plane Figures                             <ul style="list-style-type: none"> <li>• Parallelogram</li> <li>• Trapezium</li> <li>• Circle</li> </ul> </li>   <li>• Surface Area of a Right Prism with a Triangular Cross-section</li> </ul>	<p>08</p>

Competencies and Competency Levels	Subject Content	Periods
<p><b>Competency 10</b> Gets the maximum out of space by working critically with respect to volume.</p> <p>10.1 Determines the volume of prisms with different cross-sections.</p>	<ul style="list-style-type: none"> <li>• Volume of Prisms                             <ul style="list-style-type: none"> <li>• With a Triangular Cross-section (Equilateral, Isosceles, Right-angled)</li> <li>• With a Quadrilateral Shaped Cross-section (Square, Rectangle)</li> </ul> </li> </ul>	05
<p><b>Competency 11</b> Fulfills daily needs by working critically with the knowledge of liquid measures.</p> <p>11.1 Develops relationships between the various units of liquid measures.</p>	<ul style="list-style-type: none"> <li>• Relationships between the Units of Liquid Measures                             <ul style="list-style-type: none"> <li>• Milliliter and Cubic Centimeter</li> <li>• Liter and Cubic Centimeter</li> <li>• Liter and Cubic Meter</li> </ul> </li> </ul>	05
<p><b>Competency 13</b> Uses scale drawings in practical situations by exploring various methods.</p> <p>13.1 Uses angles of elevation and depression to indicate the location of an object.</p> <p>13.2 Manipulates scale drawings to represent various locations in the environment.</p>	<ul style="list-style-type: none"> <li>• Scale Drawings in a Vertical Plane                             <ul style="list-style-type: none"> <li>• Angles of Elevation and Angles of Depression</li> </ul> </li> <li>• Calculating the Distance and the Location using Scale Drawings</li> </ul>	05

Competencies and Competency Levels	Subject Content	Periods
<p><b>Competency 14</b> Simplifies algebraic expressions by systematically exploring various methods.</p> <p>14.1 Simplifies expressions by substitution.</p> <p>14.2 Simplifies binomial expressions.</p>	<ul style="list-style-type: none"> <li>• Algebraic Expressions               <ul style="list-style-type: none"> <li>• Substitution (Excluding powers and roots, Including fractions)</li> </ul> </li> <li>• Of the form <math>(x \pm a)(x \pm b)</math> <math>(a, b \in \mathbb{Z})</math></li> </ul>	06
<p><b>Competency 15</b> Factorizes algebraic expressions by systematically exploring various methods.</p> <p>15.1 Presents algebraic expressions in a simple form by factorizing them.</p> <p>15.2 Factorizes quadratic expressions to satisfy mathematical requirements.</p>	<ul style="list-style-type: none"> <li>• Factors of Algebraic Expressions               <ul style="list-style-type: none"> <li>• Common Factor a Binomial Expression; Up to Four Terms</li> </ul> </li> <li>• Of the form <math>x^2 + bx + c</math> <math>(b, c \in \mathbb{Z}, b^2 - 4c</math> a perfect square)</li> <li>• Difference of Two Perfect Squares</li> </ul>	06
<p><b>Competency 16</b> Solves problems encountered in day to day life by exploring the various methods of simplifying algebraic fractions.</p> <p>16.1 Analyses relationships in daily life by simplifying algebraic fractions.</p>	<ul style="list-style-type: none"> <li>• Algebraic Fractions               <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Addition and Subtraction (Equal denominators)</li> </ul> </li> </ul>	05

Competencies and Competency Levels	Subject Content	Periods
<p><b>Competency 17</b> Manipulates the methods of solving equations to fulfill the needs of day to day life.</p> <p>17.1 Easily solves the problems in daily life by solving simple equations.</p> <p>17.2 Solves problems by applying the methods of solving simultaneous equations.</p>	<ul style="list-style-type: none"> <li>• Solving Simple Equations                             <ul style="list-style-type: none"> <li>• With two types of brackets</li> <li>• Including Fractions</li> </ul> </li> <li>• Solving Simultaneous Equations                             <ul style="list-style-type: none"> <li>• The numerical value of the coefficient of one variable is equal</li> </ul> </li> </ul>	<p>08</p>
<p><b>Competency 19</b> Solves problems encountered in day to day life by exploring the methods by which formulae can be applied.</p> <p>19.1 Changes the subject of formulae that have been constructed to indicate the relationships between variables.</p>	<ul style="list-style-type: none"> <li>• Changing the Subject of Simple Formulae (Without powers and roots)</li> </ul>	<p>05</p>
<p><b>Competency 20</b> Easily communicates the mutual relationships that exist between two variables by exploring various methods.</p> <p>20.1 Analyses pictorial representations of the mutual linear relationship between two variables.</p>	<ul style="list-style-type: none"> <li>• Introducing Functions</li> <li>• Graphs of Straight Lines                             <ul style="list-style-type: none"> <li>• Of the form <math>y = mx</math></li> <li>• Of the form <math>y = mx + c</math></li> <li>• Of the form <math>ax + by = c</math> (For a given range)</li> <li>• Gradient and Intercept</li> </ul> </li> </ul>	<p>11</p>

Competencies and Competency Levels	Subject Content	Periods
<p>20.2 Represents the behaviour of a variable given by an inequality, in a Cartesian plane.</p> <p><b>Competency 21</b> Makes decisions by investigating the relationships between various angles.</p> <p>21.1 Confirms the relationships between angles related to straight lines.</p> <p>21.2 Identifies the relationships between the angles related to parallel lines.</p>	<ul style="list-style-type: none"> <li>• Representation of Areas in a Cartesian Plane                             <ul style="list-style-type: none"> <li>• Of the form <math>x \begin{matrix} \geq \\ &lt; \end{matrix} a</math></li> <li>• Of the form <math>y \begin{matrix} \geq \\ &lt; \end{matrix} b</math></li> <li>• Of the form <math>y \begin{matrix} \geq \\ &lt; \end{matrix} x</math></li> </ul> </li> <li>• Proof and Application of the Theorem: If two straight lines intersect one another, the vertically opposite angles are equal.</li> <li>• Application of the following Theorem and its Converse: If a transversal cuts a pair of straight lines such that                             <ul style="list-style-type: none"> <li>• the corresponding angles formed are equal to each other, or</li> <li>• the alternate angles formed are equal to each other, or</li> <li>• the sum of a pair of allied angles equals two right angles,</li> </ul>                             then the two straight lines are parallel to each other.                         </li> </ul>	<p>07</p>
<p><b>Competency 23</b> Makes decisions regarding day to day activities based on geometrical concepts related to rectilinear plane figures.</p> <p>23.1 Formally finds the sum of the three interior angles of a triangle.</p>	<ul style="list-style-type: none"> <li>• Formal Proof and Application of the Theorem: The sum of the interior angles of a triangle is <math>180^\circ</math>.</li> </ul>	<p>19</p>

Competencies and Competency Levels	Subject Content	Periods
<p>23.2 Examines the relationship between the exterior angle and the two interior opposite angles of a triangle.</p> <p>23.3 Performs calculations using the sum of the exterior and interior angles of polygons.</p> <p>23.4 Applies Pythagoras' relationship to solve day to day problems.</p>	<ul style="list-style-type: none"> <li>• Formal Proof and Application of the Theorem: If a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles.</li> <li>• Application of the Theorem: The sum of the interior angles of an <math>n</math>-sided polygon equals <math>(2n - 4)</math> right angles.</li> <li>• Application of the Theorem: The sum of the exterior angles of an <math>n</math>-sided polygon is <math>360^\circ</math>.</li> <li>• Recognizing and Applying Pythagoras' Relationship (For values that are whole numbers)</li> </ul>	05
<p><b>Competency 27</b> Analyzes according to geometric laws, the nature of the locations in the surroundings.</p> <p>27.1 Applies knowledge on the basic loci to determine the location of a point.</p> <p>27.2 Uses geometric constructions in various activities.</p>	<ul style="list-style-type: none"> <li>• Constructions                             <ul style="list-style-type: none"> <li>• The Four Basic Loci</li> <li>• The Perpendicular to a Straight Line from an Exterior Point</li> </ul> </li> <li>• <math>60^\circ</math>, <math>90^\circ</math> and Angles which are Multiples of These and <math>45^\circ</math>, <math>30^\circ</math>.</li> <li>• Copying an Angle Equal to a Given Angle</li> </ul>	
<p><b>Competency 28</b> Facilitates daily work by investigating the various methods of representing data.</p> <p>28.1 Presents data in tabular form to facilitate communication.</p>	<ul style="list-style-type: none"> <li>• Types of Data                             <ul style="list-style-type: none"> <li>• Continuous Data</li> <li>• Discrete Data</li> </ul> </li> </ul>	

Competencies and Competency Levels	Subject Content	Periods
<p><b>Competency 29</b> Makes predictions by analyzing data by various methods to facilitate daily activities.</p> <p>29.1 Investigates frequency distributions using representative values.</p>	<ul style="list-style-type: none"> <li>• Representation of a Frequency Distribution (Grouped data)                             <ul style="list-style-type: none"> <li>• Limits and Boundaries</li> <li>• Mid-Value</li> </ul> </li>   <li>• Of Grouped Data                             <ul style="list-style-type: none"> <li>• Modal Class</li> <li>• Median Class</li> <li>• Mean (Without the use of the assumed mean)</li> </ul> </li> </ul>	06
<p><b>Competency 30</b> Manipulates the principles related to sets to facilitate daily activities.</p> <p>30.1 Identifies various systems and engages in set operations.</p>	<ul style="list-style-type: none"> <li>• Sets                             <ul style="list-style-type: none"> <li>• Finite Sets, Infinite Sets</li> <li>• Subsets of a Set</li> <li>• Complement of a Set</li> <li>• Set Operations                                     <ul style="list-style-type: none"> <li>• Intersection</li> <li>• Union</li> </ul> </li> </ul> </li> </ul>	05
<p><b>Competency 31</b> Analyzes the likelihood of an event occurring to predict future events.</p> <p>31.1 Investigates the likelihood of an event occurring based on the occurrences.</p>	<ul style="list-style-type: none"> <li>• Randomness</li> <li>• Sample Space</li> <li>• Probability (Of equally likely events)</li> </ul>	05



## Grade 9

### Relationship between Mathematics Subject Themes and Content

Content	Learning Outcomes
<p><b>1.0 Numbers</b></p> <p>1.1 Scientific Notation</p> <ul style="list-style-type: none"> <li>• Large Numbers</li> <li>• Decimal Numbers</li> </ul> <p>1.2 Rounding Off</p> <ul style="list-style-type: none"> <li>• Whole Numbers</li> <li>• Decimal Numbers</li> </ul> <p>1.3 Number Patterns</p> <p>1.4 Fractions</p> <ul style="list-style-type: none"> <li>• With brackets and 'of'</li> <li>• Laws of Simplification</li> </ul> <p>1.5 Direct Proportions</p> <ul style="list-style-type: none"> <li>• Unitary Method</li> <li>• Foreign Currency</li> </ul> <p>1.6 Percentages</p> <ul style="list-style-type: none"> <li>• Profit, Loss</li> <li>• Discounts, Commissions</li> <li>• Simple Interest               <ul style="list-style-type: none"> <li>• Annual/Monthly Interest Rates</li> <li>• Calculation of Interest</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Writes large numbers in scientific notation.</li> <li>• Writes decimal numbers in scientific notation (<math>p = a \times 10^n, n \in Z, 1 \leq a &lt; 10</math>).</li> <li>• Rounds off whole numbers up to a million to the nearest 10, 100, 1000.</li> <li>• Rounds off a decimal number to a given decimal place.</li> <li>• Writes down the general term of a given number pattern.</li> <li>• Simplifies expressions with fractions that include brackets and 'of'.</li> <li>• Simplifies expressions that include fractions by applying the rules of simplification (BODMAS).</li> <li>• Solves direct proportion problems using the unitary method.</li> <li>• Solves problems that involve the conversion of foreign currency.</li> <li>• Calculates profit and loss in transactions.</li> <li>• Engages in calculations related to discounts and commissions.</li> <li>• Calculates the interest for a given amount and given time period based on a given monthly or annual interest rate.</li> </ul>

Content	Learning Outcomes
<p>1.7 Indices</p> <ul style="list-style-type: none"> <li>• Zero Index</li> <li>• Negative Indices</li> <li>• Laws of Indices               <ul style="list-style-type: none"> <li>• Multiplication</li> <li>• Division</li> <li>• Power of a Power</li> </ul> </li> <li>• Writing as Logarithms               <ul style="list-style-type: none"> <li>• Expressions with Indices</li> <li>• Logarithms <math>\Leftrightarrow</math> Powers</li> </ul> </li> <li>• Use of the Keys of a Calculator               <ul style="list-style-type: none"> <li>• =, %, <math>x^2</math>, <math>\sqrt{x}</math></li> </ul> </li> </ul> <p>2.0 Measurements</p> <p>2.1 Perimeter</p> <ul style="list-style-type: none"> <li>• Diameter of a Circle</li> <li>• Circumference of a Circle</li> <li>• Relationship between the Diameter and Circumference of a Circle</li> <li>• Use of Formulae</li> </ul> <p>2.2 Area</p> <ul style="list-style-type: none"> <li>• Plane Figures               <ul style="list-style-type: none"> <li>• Parallelogram</li> <li>• Trapezium</li> <li>• Circle</li> <li>• Surface Area                   <ul style="list-style-type: none"> <li>• Prism</li> </ul> </li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Simplifies powers with zero index and negative indices.</li> <li>• Simplifies expressions with indices by applying the laws of indices.</li> <li>• Writes powers as logarithms and logarithms as powers by developing the relationship between indices and logarithms.</li> <li>• Performs calculations easily by using a calculator.</li> <li>• Measures the diameter of a circular bangle or lamina</li> <li>• Measures the circumference of a circular bangle or a lamina.</li> <li>• Constructs a formula for the circumference by considering the relationship between the diameter and circumference of a circle.</li> <li>• Performs calculations by using the formulae for the circumference of a circle.</li> <li>• Calculates the area of a parallelogram.</li> <li>• Calculates the area of a trapezium.</li> <li>• Calculates the area of a circle.</li> <li>• Calculates the surface area of a right prism with a triangular cross-section.</li> </ul>

Content	Learning Outcomes
<p>2.3 Volume</p> <ul style="list-style-type: none"> <li>• Prism                             <ul style="list-style-type: none"> <li>• With a triangular cross-section</li> <li>• With a quadrilateral shaped cross-section</li> </ul> </li> </ul> <p>2.4 Liquid Measures</p> <ul style="list-style-type: none"> <li>• Relationship between Units                             <ul style="list-style-type: none"> <li>• Milliliters and Cubic Centimeters</li> <li>• Liters and Cubic Centimeters</li> <li>• Liters and Cubic Meters</li> </ul> </li> </ul> <p>2.5 Scale Drawings in a Vertical Plane</p> <ul style="list-style-type: none"> <li>• Angle of Elevation and Angle of Depression</li> <li>• Distance and Location by considering Scale Drawings</li> </ul> <p><b>3.0 Algebra</b></p> <p>3.1 Algebraic Expressions</p> <ul style="list-style-type: none"> <li>• Substitution</li> <li>• Expansion of Binomial Expressions</li> </ul>	<ul style="list-style-type: none"> <li>• Calculates the volume of a right prism with an equilateral triangle shaped cross-section.</li> <li>• Calculates the volume of a right prism with an isosceles triangle shaped cross-section.</li> <li>• Calculates the volume of a right prism with a right-angled triangle shaped cross-section.</li> <li>• Calculates the volume of a right prism with a square cross-section.</li> <li>• Calculates the volume of a right prism with a rectangular cross-section.</li> </ul> <ul style="list-style-type: none"> <li>• Determines the relationship between <math>ml</math> and <math>cm^3</math>.</li> <li>• Determines the relationship between <math>l</math> and <math>cm^3</math>.</li> <li>• Determines the relationship between <math>l</math> and <math>m^3</math>.</li> </ul> <ul style="list-style-type: none"> <li>• Describes the location of an object by considering the angle of elevation and the angle of depression.</li> <li>• Makes scale drawings by considering the location.</li> <li>• Describes the location by considering scale drawings.</li> </ul> <ul style="list-style-type: none"> <li>• Finds the value of an algebraic expression without powers and roots, by substituting numbers (Including fractions).</li> <li>• Simplifies binomial expressions of the form <math>(x \pm a)(x \pm b)</math>, <math>(a, b \in \mathbb{Z})</math>.</li> </ul>

Content	Learning Outcomes
<p>3.2 Factors</p> <ul style="list-style-type: none"> <li>• Expressions with Four Terms</li> <li>• Quadratic Expressions</li> <li>• Difference of Two Squares</li> </ul> <p>3.3 Algebraic Fractions</p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Addition and Subtraction</li> </ul> <p>3.4 Solving Equations</p> <ul style="list-style-type: none"> <li>• Simple Equations</li> <li>• Simultaneous Equations</li> </ul> <p>3.5 Formulae</p> <ul style="list-style-type: none"> <li>• Changing the Subject</li> </ul> <p>3.6 Graphs</p> <ul style="list-style-type: none"> <li>• Function</li> <li>• The Graph of Straight Lines</li> </ul>	<ul style="list-style-type: none"> <li>• Determines the factors of an expression with 4 algebraic terms, when the common factor is a binomial expression. (Such as <math>ax + ay + cx + cy</math>)</li> <li>• Factors an algebraic expression of the form <math>x^2 + bx + c</math> (<math>b, c \in \mathbb{Z}</math>, <math>b^2 - 4c</math> is a perfect square)</li> <li>• Determines the factors of an algebraic expression given as a difference of two perfect squares.</li> <li>• Recognizes algebraic fractions.</li> <li>• Adds; subtracts algebraic fractions with equal denominators.</li> <li>• Solves simple equations with two types of brackets.</li> <li>• Solves simple equations that include fractions.</li> <li>• Solves simultaneous equations in which the numerical coefficient of one variable is equal.</li> <li>• Changes the subject of a formula without powers and roots.</li> <li>• Recognizes the relationship between <math>y</math> and <math>x</math> in equations of the form <math>y = mx + c</math>, as a function.</li> <li>• For a given domain, sketches the graph of functions of the form <math>y = mx</math>.</li> <li>• For a given domain, sketches the graph of functions of the form <math>y = mx + c</math>.</li> <li>• For a given domain, sketches the graph of <math>ax + by + c = 0</math>.</li> <li>• Identifies the gradient and intercept of the graph of a straight line.</li> </ul>

Content	Learning Outcomes
<ul style="list-style-type: none"> <li>• Inequalities               <ul style="list-style-type: none"> <li>• Representation on a Cartesian Plane</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Represents inequalities of the form <math>x \begin{matrix} \geq \\ &lt; \end{matrix} a</math> on a coordinate plane.</li> <li>• Represents inequalities of the form <math>y \begin{matrix} \geq \\ &lt; \end{matrix} b</math> on a coordinate plane.</li> <li>• Represents inequalities of the form <math>y \begin{matrix} \geq \\ &lt; \end{matrix} x</math> on a coordinate plane.</li> </ul>
<p><b>4.0 Geometry</b></p>	
<p>4.1 Vertically Opposite Angles formed by the Intersection of Two Straight Lines</p>	<ul style="list-style-type: none"> <li>• Proves the theorem: If two straight lines intersect one another, the vertically opposite angles are equal.</li> <li>• Solves problems by applying the above theorem.</li> </ul>
<p>4.2 Angles related to Parallel Lines</p>	<ul style="list-style-type: none"> <li>• Applies the following theorem and its converse: If a transversal cuts a pair of straight lines such that               <ul style="list-style-type: none"> <li>• the corresponding angles formed are equal to each other, or</li> <li>• the alternate angles formed are equal to each other, or</li> <li>• the sum of a pair of allied angles equals two right angles,</li> </ul>               then the two straight lines are parallel to each other.             </li> </ul>
<p>4.3 Interior Angles of a Triangle</p>	<ul style="list-style-type: none"> <li>• Proves and applies the theorem: The sum of the interior angles of a triangle is <math>180^\circ</math>.</li> </ul>
<p>4.4 Exterior Angles formed by Producing the Sides of a Triangle</p>	<ul style="list-style-type: none"> <li>• Proves and applies the theorem: If a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles.</li> </ul>
<p>4.5 Sum of the Interior Angles of Polygons</p>	<ul style="list-style-type: none"> <li>• Applies the theorem: The sum of the interior angles of an <math>n</math>-sided polygon equals <math>(2n - 4)</math> right angles.</li> </ul>

Content	Learning Outcomes
<p>4.6 Pythagoras' Relationship for Right Angled Triangles</p> <p>4.7 Constructions</p> <ul style="list-style-type: none"> <li>• Four Basic Loci</li> </ul> <ul style="list-style-type: none"> <li>• Construction of Perpendiculars</li> <li>• Construction and Copying of Angles</li> </ul> <p><b>5.0 Statistics</b></p> <p>5.1 Data</p> <ul style="list-style-type: none"> <li>• Types of Data</li> <li>• Representation of Data</li> </ul> <p>5.2 Representative Value</p> <ul style="list-style-type: none"> <li>• Modal Class</li> <li>• Median Class</li> <li>• Mean</li> </ul>	<ul style="list-style-type: none"> <li>• Applies the theorem: The sum of the exterior angles of an <math>n</math>-sided polygon equals <math>360^\circ</math>.</li> <li>• Applies Pythagoras' relationship to solve problems. (For values that are whole numbers only)</li> <li>• Constructs the locus of a point a constant distance from a given point.</li> <li>• Constructs the locus of a point equi-distant from two given points.</li> <li>• Constructs the locus of a point a constant distance from a straight line.</li> <li>• Constructs the locus of a point equi-distant from two intersecting straight lines.</li> <li>• Constructs a perpendicular to a straight line from an exterior point.</li> <li>• Constructs <math>60^\circ</math>, <math>90^\circ</math> and angles which are multiples of these as well as <math>45^\circ</math> and <math>30^\circ</math>.</li> <li>• Copies an angle equal to a given angle.</li> <li>• Identifies continuous data and discrete data.</li> <li>• Prepares a frequency distribution for a given set of data.</li> <li>• Determines the class limits, boundaries and mid-value of a frequency distribution.</li> <li>• Determines the modal class of a grouped frequency distribution.</li> <li>• Determines the median class of a grouped frequency distribution.</li> <li>• Calculates the mean of a grouped frequency distribution.</li> </ul>

Content	Learning Outcomes
<p><b>6.0 Sets and Probability</b></p> <p>6.1 Sets</p> <ul style="list-style-type: none"> <li>• Introducing Sets</li> <li>• Subsets</li> <li>• Set Operations                             <ul style="list-style-type: none"> <li>• Intersection</li> <li>• Union</li> </ul> </li> </ul> <p>6.2 Probability</p> <ul style="list-style-type: none"> <li>• Likelihood of an Occurrence</li> <li>• Sample Space</li> <li>• Equally Likely Events</li> </ul>	<ul style="list-style-type: none"> <li>• Identifies finite sets, infinite sets and the complement of a set.</li> <li>• Writes down the subsets of a given set.</li> <li>• Writes down the elements of the set that is obtained by the intersection of two sets.</li> <li>• Writes down the elements of the set that is obtained by the union of two sets.</li> <li>• Recognizes random occurrences.</li> <li>• Writes down the sample space of a random occurrence.</li> <li>• Calculates the probability of an equally likely event.</li> </ul>

**Lesson Sequence, Competency Levels and Number of Periods**

<b>Content</b>	<b>Competency Levels</b>	<b>Number of Periods</b>
<b>Term 1</b>		
01 Rounding Off and Scientific Notation	1.1, 1.2	05
02 Number Patterns	2.1	05
03 Fractions	3.1	06
04 Percentages	5.1	05
05 Simple Interest	5.2	06
06 Algebraic Expressions	14.1, 14.2	06
07 Factors of Algebraic Expressions	15.1, 15.2	06
08 Angles related to Straight Lines, Parallel Lines	21.1, 21.2	07
09 Liquid Measurements	11.1	05
		51
<b>Term 2</b>		
10 Direct Proportions	4.1	04
11 Calculator	6.3	04
12 Indices and Logarithms	6.1, 6.2	08
13 Constructions	27.1, 27.2	05
14 Equations	17.1, 17.2	08
15 Angles of a Triangle	23.1, 23.2	06
16 Formulae	19.1	05
17 Circumference of a Circle	7.1	05
18 Pythagoras' Relationship	23.4	07
19 Graphs	20.1	07
		59
<b>Term 3</b>		
20 Inequalities	20.2	04
21 Sets	30.1	05
22 Area	8.1, 8.2	08
23 Probability	31.1	05
24 Angles of Polygons	23.3	06
25 Algebraic Fractions	16.1	05
26 Volume	10.1	05
27 Scale Drawing	13.1, 13.2	05
28 Data Representation and Data Interpretation	28.1, 29.1	11
		54
		<u><b>164</b></u>



## School Policies and Programmes

The mathematics syllabus has been prepared not only with the objective of inculcating knowledge and skills but also to highlight the deeper aims of communication, relationships, logical argument and problem solving. The latterly mentioned four aims aid more effectively in the development of behavioral and thinking skills. Mathematics is a subject that should not be restricted to just the syllabus or the classroom. It should be made into an active force within the school culture itself as it is a language; a science; an art; a tool to be used in thought, in calculations and in creations.

It is important therefore to organize school programmes so that the cultural values embedded in mathematics are developed in students. The following co-curricular programmes will aid in this.

1. Wall newspapers
2. Mathematics Laboratory
3. Mathematics Library
4. Exhibitions
5. Mathematics Societies
6. Quizzes
7. Mathematics Magazines
8. Mathematics Days
9. Mathematics Camps
10. Activity Cells
11. Excursions

In operating this co-curricular programme, the school management should aim at obtaining the help of the community when required and also getting experts to teach some of the subject content.

If your school does not have a trained mathematics teacher for this grade, it is appropriate to engage a teacher who has the required subject knowledge and a penchant for teaching mathematics for this task. Mathematics teacher should continuously update their knowledge on subject material and teaching methodologies. For this, it is appropriate to get advice from the zonal mathematics director/ mathematics in-service advisors and senior graduate teachers. It is also necessary to participate in training sessions.

It is hoped that the school management will work towards allocating one of the free periods in the time table under the new reforms, for mathematics.

It is most likely that it will not be possible to complete a proposed exploration activity within a period, due to most activities being longer than 40 minutes. In such instances, the next mathematics period should be used to complete the activity.

To facilitate the tasks of the students as well as the teacher, chairs should be placed in a semi-circle during exploration activities. The quality inputs required for the activities are given under each activity in the chapter on learning teaching methodology. It would be easier to buy all the quality inputs for the year at once at the beginning of the year.

In guiding the learning teaching process, it is important to provide instructions by paying special attention to the following:

- Determining whether the students are engaged in exploration according to the E-5 model
- Carrying out assessment and evaluation at the appropriate times

It is also expected that attention will be paid to the following, which are proposed as remedies to the problems encountered when the competency based syllabi were operated in the school system in year 2007 in grades 6 and 10.

- The tasks in the instruction leaflet on exploration should be distributed randomly among the groups.
- Groups should be organized according to the number of students in the class. (If tasks have been assigned for 4 groups, the number of groups should be taken as a multiple of this number, depending on how many more/less students are in the class).
- Instead of appointing a leader, the opportunity should be provided for a person within the group itself to volunteer to be the leader.
- Students should first be engaged in the exploration process, and once the relevant mathematical concepts have been grasped through this process, the remaining time should be used for exercises.
- When a review is being done after the exploration process is concluded, students should be provided with the opportunity to write a summarized note on the lesson in their exercise books.
- Depending on the number of evaluations that should be carried out in a term, apart from the instruments for the extension of the learning – teaching process, to carry out the evaluations, appropriate activities should be selected and marks should be allocated.

# ***Learning – Teaching Methodology***

## Introduction

In deciding upon the learning teaching methodology relevant to the course, attention has been paid to the planning of learning-teaching activities that facilitate building up of student competencies based on exploration. In preparing for a competency-based education of this manner, an obvious change in the role of the teacher is expected.

The transmission role practiced in our classroom from way back and the more recently introduced transaction role is evident in the classroom even today. When taking into consideration the deterioration of the thinking, social and personal skills of school leavers, no effort is needed to understand that there is a need for the development of the learning-teaching methodology and how it should be effected.

In the transmission role, the teacher is considered an individual who knows everything that the student should learn, and his task is that of transmitting knowledge to the student who is considered as one who does not know anything. This learning-teaching process that takes the guise of lectures is restricted only to the flow of knowledge from the teacher to the student, and does not make an adequate contribution either to the stimulation of student thinking or to the development of his personal and social skills.

The dialogue initiated by the teacher within the class is the initial stage of the transaction role. Apart from the ideas that flow from the teacher to the class and from the class to the teacher, as a result of the student-student interactions that takes place subsequently, these dialogues transform gradually into discussions. The teacher is continuously involved in the task of questioning in order to take the student from the known to the unknown, from the simple to the complex and from the concrete to the abstract.

While, in competency-based education, student tasks occupy a powerful position, the teacher takes on the role of a resource person who mediates in order to provide every student in the class with a competency that is at least proximate to the required competency. For this, the basic functions that the teacher is expected to perform include initiating the activity in a manner that will kindle interest, planning the learning environment with the necessary materials and other facilities, closely observing how students learn, identifying student abilities and inabilities and promoting student learning through the provision of feedback and feed-forward, paying close attention to student presentations and discussions, as well as preparing instruments for the extension of learning beyond the classroom. The teacher's role based essentially upon the tasks mentioned above is called the transformation role.

The series of activities that can be used in the implementation of the descriptive curriculum introduced in the first part of this teacher's instructional manual, has been included in its second part. Each of these activities has been developed so as to contain a minimum of three steps. It is expected to get the student involved in the learning process through the first step of the activities. Therefore, this step is termed the "engagement" step. As an introduction to this step, the teacher assumes the transaction role and engages in a

dialogue with the students. Subsequently, along with the transformation of this dialogue to a discussion, the students engage in exploration and are provided the opportunity to recall the pre-knowledge related to the basic competency they should develop, and to acquire a hint regarding the future of the activity. The teacher possesses a host of strategies that can be used in these exchanges of ideas. Some of the devices at the disposal of the teacher for the exchange of these ideas are questions/stimulants like pictures, newspaper advertisements and flash cards/puzzles or case studies/dialogues, role play, poems, songs and demonstrations, video tapes or audio tapes. In summary, the first step of the activities is implemented with the aim of actualizing the following three objectives.

- Winning over of the attention of the class.
- Providing the students with the opportunity for students' recall of the necessary pre-knowledge.
- Introducing the elements of the exploration the students are expected to be directed to under the second step of the activity.

It is with the objective of providing the students with the opportunity for exploration that the second step of the activity has been planned. Students base their exploration on a special leaflet prepared for the purpose. The teacher has to plan this step to enable the students to engage in co-operative learning in groups, through the exploration of various aspects of the problem. Two of the most important features of this step are the use of the resource materials provided and conscious involvement in group discussions. As a result of involvement in group activities throughout a long period of time, students will develop a number of essential skills like self-discipline, listening to others, working co-operatively with others, helping others, time management, producing high quality creations, honesty etc.

In directing students towards exploration, the teacher should avoid making decisions regarding leadership in the group, but he/she should prepare the background necessary for a leader to emerge. Accordingly, when opportune, the students will have the privilege of taking on leadership, based on inherent abilities.

During the 3<sup>rd</sup> step of the activity, every group will have the opportunity of presenting the results of its exploration for the enlightenment of the others. What the teacher has to do here is to encourage student involvement in group presentations. It would be effective if students are directed, so as to ensure that every member is given responsibility in the planning of the presentation. An important aspect of this step, related to the explanation of student findings, is the creation of the opportunity for the voice of students to be heard in the classroom, where commonly the voice of the teacher dominated.

After the explanation of the findings in the third step of the activities, students should be directed to elaboration. Each group is given the opportunity to provide constructive suggestions on its findings first, and subsequently, members of other groups are given this opportunity. Anyway, the final review is the responsibility of the teacher. During this review, the teacher is expected to clarify all the important points relevant to the students' exploration as well as to instill in students the right understanding of the concepts and rules.

The main responsibility of the teacher in this teaching methodology is to monitor continuously whether the classroom learning-teaching process is being implemented successfully and as expected. While assessment and evaluation should be made use of for this purpose, the teacher is provided the opportunity to carry this out, through planned activities, in the learning teaching process itself. The teacher is given the opportunity for assessment while the students are involved in exploration during the second stage of the activity and for evaluation when the students are involved in explanation and elaboration during the third stage. A detailed inquiry into assessment and evaluation will be provided later on in this document.

The teacher is provided direction on the transformation role by the learning – teaching methodology described so far. While priority is given to group exploration here, the teacher is also afforded the opportunity for transaction, discussion and short lectures. While there is room for transaction and discussion in the initial stage, the teacher may also give a short lecture to confirm the concepts, under review, in the final stage. In the development of the learning-teaching methodology related to this curriculum, the first to be introduced under the curriculum reforms for the new millennium, the attention paid to the important aspects of the transmission and the transaction roles of the teacher, apart from the transformation role, is a special feature of this methodology.

# *Activity Continuum*

## 01. Rounding Off and Scientific Notation I

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

**Competency Level 1.1** : Organizes numbers in ways that they can be manipulated easily.

**Time** : 50 minutes.

### Learning –Teaching Process:

#### Step 1 :

Discuss with the students regarding how a fraction can be written as a decimal number and regarding multiplying and dividing decimal numbers such as 2.38, 35.2 and 0.257 by powers of 10.

During this discussion, highlight the following facts.

- That when writing a fraction as a decimal number, the numerator of the fraction must be divided by the denominator.
- That when a decimal number is multiplied by a power of 10, the decimal point of the decimal number shifts to the right by the same number of positions as the number of zeroes in the power of 10 by which it is multiplied .
- That when a decimal number is divided by a power of 10, the decimal point of the decimal number shifts to the left by the same number of positions as the number of zeroes in the power of 10 by which it is divided.

(10 minutes)

#### Step 2 :

Engage the students in an analytical study by using the following leaflet on exploration.

#### Leaflet on Exploration

Focus your attention on the case relevant to your group from the following cases.

	A	B	C
Part I	10 - 100	100 - 1000	1000 – 10 000
Part II	3753	4165	5463

- Write down five numbers which lie within the range of numbers of the case your group obtained in Part I.
- Write each of these five numbers as a product of a number which lies between 1 and 10 and a number which is a power of 10.



- Can any large number be written as a product of a number between 1 and 10 and a number which is a power of ten, as in the above examples?
- Find instances in other subjects when large numbers have been used in this manner.
- Propose a name that can be used to define this method of writing numbers as a product of a number between 1 and 10 and a number which is a power of ten.
- Write the number in Part II which your group received, as a product of a number between 1 and 10 and a number which is a power of ten.
- Carefully study the chart given below and fill in the blanks.

$1000 = 10^3$
$100 = 10^2$
$10 = 10^1$
$0.1 = \frac{1}{10} = 10^{-1}$
$0.01 = \frac{1}{100} = 10^{-2}$
$0.001 = \frac{1}{1000} = \dots\dots\dots$
$0.006 = \frac{6}{1000} = \dots\dots\dots$

- Focus your attention on the case relevant to your group from the cases given below.

A	B	C
0.341	0.0231	0.0043
0.573	0.0315	0.0093

- Write each number your group received as a division of a number between 1 and 10, by a power of ten.
- Write these numbers as a product of a number between 1 and 10 and a number which is a power of ten.
- What can you say about the advantages of writing large numbers as well as small numbers in this manner?
- Prepare to present your findings to the rest of the students in your class.

(30 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That any non-zero number can be written as a product of a number between 1 and 10 and a number which is a power of ten.
- That the above manner of writing a number is called "scientific notation".
- That the index of the power of ten is negative when a number between 0 and 1 is written in scientific notation.
- That manipulation of numbers is facilitated by writing them in scientific notation.

(10 minutes)

**Criteria for Assessment and Evaluation:**

- Writes a given large number as a product of a number between 1 and 10 and a number which is a power of ten.
- Writes a decimal number in scientific notation.
- Writes any given number in scientific notation.
- Uses various methods to facilitate communication.
- Works as a team to make the process a success.

## 01. Rounding Off and Scientific Notation II

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

**Competency Level 1.2** : Determines approximate values to facilitate manipulation.

**Time** : 60 minutes.

### Learning –Teaching Process:

#### Step 1 :

Write the sentence “The population in the village Samagi-pura is 25 874” on the blackboard, and lead a discussion so that the following facts on how the number is read, the place value of the digits and the value represented by each digit are highlighted.

- That the number is read as twenty five thousand eight hundred and seventy four.
- That the place value of each digit beginning from 4, the rightmost digit of the number, and moving to the left is respectively 1, 10, 100, 1000 and 10 000.
- That the value represented by each digit from the right to the left is respectively, 4, 70, 800, 5000 and 20 000.
- That the decimals are placed to the right of the ‘units’ position.
- That the first position to the right of the decimal point is defined as the first decimal place, the second position as the second decimal place and so on.
- That 26 000 can be considered as an approximate value of 25 874.

(10 minutes)

#### Step 2 :

Engage the students in exploration and the preparation of a report with the aid of the following leaflet on exploration

#### Leaflet on Exploration

Rounding off is giving an approximate value for a number, according to a certain law

- Focus your attention on the case of rounding off assigned to your group from the following cases.
  - Rounding off to the nearest 10
  - Rounding off to the nearest 100
  - Rounding off to the nearest 1000

- Let each member of the group write down a four digit number which does not include the digit 0. Circle the digit that has as its place value the value to which the number is to be rounded off.
- Focus your attention on the value represented by the digit that has been circled and find the nearest multiple of 10 or 100 or 1000 of the number represented by the digits on the right of the digit that has been circled.
- Thereby round off your number to the value assigned.
- Discuss how rounding off is done if the digit to the right of the digit that has as its place value the value to which the number is to be rounded off, is the digit 5.
- Round of 35 555 to the nearest 10/100/1000.
- Write down all the whole numbers that can be obtained by rounding off the number 2780, and find the largest and smallest of these numbers.
- Write down a seven digit number and round it off to the nearest 10/100/1000.
- Round off 83.275 to the first decimal place by identifying the relevant place value and the digit to the right of its position.
- Prepare a creative report for a wall newspaper describing how rounding off is done.
- Prepare to present your findings and report at the plenary session.

(30 minutes)

### Step 3 :

After the students' presentations, lead a discussion and highlight the following facts.

- That rounding off can be used to get a rough idea regarding large numbers.
- That rounding off is done according to a law.
- That if the digit that appears to the right of the digit that has as its place value the value to which the number is to be rounded off, is less than 5, then in rounding off, this digit (which is less than 5) and all others to its right are replaced by zero, while the rest of the digits are left unchanged.
- That if this digit is greater or equal to 5, rounding off is done by adding 1 to the digit that has as its place value the value to which the number is to be rounded off, while all the digits to the right of it are replaced by 0 and the rest are left unchanged.
- That the same law is applied in relation to decimal numbers also.
- That rounding off is giving an approximate value for a number, according to a certain law and that in estimating a value, no such law is applied.

(20 minutes)

### Criteria for Assessment and Evaluation:

- Rounds off a whole number to the nearest 10.
- Rounds off any whole number up to a million to the nearest 10, nearest 100.
- Rounds off any number to the required place value.
- Finds easy applications in daily tasks.
- Develops relationships by investigating information.

## 02. Number Patterns

**Competency 2** : Makes decisions for future requirements by investigating the various relationships in number patterns.

**Competency Level 2.1** : Constructs the general term by observing the relationship between the terms of the number pattern.

**Time** : 80 minutes.

### Learning –Teaching Process:

#### Step 1 :

Present number patterns of the following types to the class and inquire from the students regarding the relationship between the terms and how the  $n^{\text{th}}$  term is obtained.

5, 10, 15, 20, ...

1, 4, 9, 16, ...

1, 3, 6, 10, ...

Lead a discussion and highlight the following facts.

- That by identifying the relationship between the terms of a number pattern, the next few terms can be obtained.
- That the  $n^{\text{th}}$  term of a number pattern can be constructed based on the relationship between the given terms.

(10 minutes)

#### Step 2 :

Engage the students in an exploration by using the following leaflet on exploration.

#### Leaflet on Exploration

- Focus your attention on the pair of number patterns assigned to your group.

(i) 3, 5, 7, 9, ... (ii) 1, 0, -1, -2, ...	(i) $1, 1\frac{1}{2}, 2, 2\frac{1}{2}, \dots$ (ii) 1, -1, -3, -5, ...
(i) 2, 5, 8, 11, ... (ii) -1, -3, -5, -7, ...	(i) 0, 3, 6, 9, ... (ii) -6, -8, -10, -12, ...

- Observe the relationship between the given terms of the first number pattern and write down the next two terms of the pattern.
- By considering this relationship, write down the first term of this number pattern in terms of 1, the second term in terms of 2 and the third term in terms of 3.
- In the above manner, write the 8<sup>th</sup> term in terms of 8.
- Construct the  $n^{\text{th}}$  term of the first number pattern assigned to your group, in terms of  $n$ .
- Similarly, construct the  $n^{\text{th}}$  term of the second number pattern in terms of  $n$ . Propose another suitable name for this  $n^{\text{th}}$  term.
- Express your ideas regarding the importance of the expression you obtained for the  $n^{\text{th}}$  term.
- Write down the first three terms of the number pattern with  $n^{\text{th}}$  term given by the expression  $3n - 2$ .
- Prepare for a presentation at the plenary session.

(40 minutes)

### Step 3 :

After the students' presentations, lead a discussion and highlight the following facts.

- That the  $n^{\text{th}}$  term of a number pattern can be written down by identifying the relationship between the given terms of the pattern.
- That the  $n^{\text{th}}$  term of a number pattern is the general number.
- That any term of a number pattern could be found using the expression for the  $n^{\text{th}}$  term.

(30 minutes)

### Criteria for Assessment and Evaluation:

- Recognizes the relationship between the terms of a number pattern and writes down the next few terms.
- When an expression for the  $n^{\text{th}}$  term is given, writes down the terms of a number pattern that are named.
- Writes down the  $n^{\text{th}}$  term of a number pattern in terms of  $n$ .
- Develops relationships by considering the special features of a pattern.
- Makes decisions for future requirements with an understanding of relationships.

### 03. Fractions

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

**Competency Level 3.1** : Methodically simplifies expressions with fractions.

**Time** : 80 minutes.

**Learning –Teaching Process:**

**Step 1 :**

To recall students’ knowledge, present several problems on fractions and lead a discussion and highlight the following facts.

- That when adding or subtracting fractions, the denominators should be made equal.
- That when multiplying fractions, simplification can be done by first converting mixed numbers into improper fractions and then cancelling out the factors that are common to both the numerator and the denominator.
- That when dividing fractions, the solution can be obtained by multiplying the dividend by the reciprocal of the divisor.
- That when simplifying fractions, any part within brackets should be simplified first.

(10 minutes)

**Step 2 :**

Engage the students in an analytical study by using the following leaflet on exploration.

<b>Leaflet on Exploration</b>		
Activity Group Number	A	B
I	$\frac{2}{3} + \frac{3}{4} - \frac{1}{6}$	$\frac{1}{4} \div \frac{1}{3} \times 4$
II	$\frac{2}{5} + \frac{1}{7} - \frac{1}{5}$	$\frac{3}{5} \times \frac{1}{4} \div 3$
III	$\frac{1}{3} - \frac{1}{7} + \frac{1}{4}$	$\frac{7}{12} \div 4 \times \frac{1}{7}$

- Simplify the expressions you obtained under A and B in the given order.
- Place brackets in the expression in Part B such that the second operation of the expression could be performed first, and obtain the solution by first simplifying the part within the brackets.
- What can you say about the solutions you obtained in the above two instances?
- Accordingly, what is the procedure that could be followed when simplifying expressions with fractions in which brackets have not been used?
- Prepare to present your findings to the other students in the class.

(40 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That changing the order in which the operations are performed in expressions with only addition and subtraction does not affect the solution.
- That changing the order in which the operations are performed in expressions with multiplication and division affects the solution.
- That brackets are used to show priority in the order.
- That when no brackets are used, there is a convention for the order of performing operations.
- That this convention can be remembered easily as "BODMAS".

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Accurately simplifies expressions with fractions which involve addition and subtraction.
- Accurately simplifies expressions with fractions which involve multiplication and division.
- Accurately simplifies expressions with fractions.
- Expresses the importance of order in an action.
- Obtains accurate results by working methodically and according to conventions.



## 04. Percentages

**Competency 5** : Makes successful transactions in the modern world by using percentages.

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

**Time** : 120 minutes.

**Learning –Teaching Process:**

**Step 1 :**

**In a certain Navodya School,  
the number of boys in Grade 8D is 24  
and  
the number of girls in Grade 8D is 16**

Present an enlarged copy of the above poster to the class and using it lead a discussion. During this discussion, highlight the following facts.

- That the total number of students is 40.
- That the number of boys in the class can be represented as a fraction of the total number of students in the class.
- That the number of boys in the class can be represented as a percentage of the total number of students in the class.
- That the number of girls in the class too can be represented as a percentage of the total number of students in the class.
- That any fraction can be written as a percentage.
- That any percentage can be written as a fraction.

(20 minutes)

**Step 2 :**

Engage the students in an analytical study by using the following leaflet on exploration.

<b>Leaflet on Exploration</b>	
Four instances of transactions carried out in a market-place are given below	
<p style="text-align: center;"><b>Case I</b></p> <p><i>a.</i> Radha was able to make a <b>profit</b> by selling a clock she bought for Rs. 400 at the price of Rs. 480.</p> <p><i>b.</i> That a <b>profit</b> can also be made by selling an item bought for Rs. 380 at the price of Rs. 394.</p>	<p style="text-align: center;"><b>Case II</b></p> <p><i>a.</i> Raja incurred a <b>loss</b> by having to sell a radio that he had bought for Rs. 625 at the price of Rs. 500.</p> <p><i>b.</i> That a <b>loss</b> is also incurred by having to sell an item bought for Rs. 640 at the price of Rs. 576.</p>
<p style="text-align: center;"><b>Case III</b></p> <p><i>a.</i> When buying at item worth Rs. 800 a <b>discount</b> of Rs. 40 was obtained.</p> <p><i>b.</i> A <b>discount</b> of Rs. 48 was obtained on an item worth Rs. 1200.</p>	<p style="text-align: center;"><b>Case IV</b></p> <p><i>a.</i> A salesperson receives a <b>commission</b> of Rs. 50 when he sells an item worth Rs. 1000.</p> <p><i>b.</i> A <b>commission</b> of Rs. 245 is obtained for the sale of an item worth Rs. 4900.</p>

- Focus your attention on the case received by your group.
- Write event '*a*' in terms of percentages.
- Write event '*b*' in terms of percentages.
- Determine which of the two events '*a*' or '*b*' is the better transaction.
- Discuss why percentages are important in market-place transactions.
- Prepare for a presentation at the plenary session.

(60 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That Profit = Selling Price – Purchase Price.
- That Loss = Purchase Price – Selling Price.
- That discount is the reduction made in the stated price during a sale.
- That commission is the amount paid to an agent from the income obtained through a transaction carried out by the agent.
- That profit, loss, discount and commission can be represented as percentages.
- That percentages are used in abundance in market-place transactions.
- That percentages are used mainly due to the fact that comparison is facilitated.

(40 minutes)

**Criteria for Assessment and Evaluation:**

- Understands and explains the meaning of the terms profit, loss, discount and commission.
- Uses percentages as a good indicator when making comparisons.
- Expresses profit, loss, discount and commission as a percentage.
- Works in cooperation within the group to make the process a success.
- Is inclined to compare market-place transactions by using percentages.

## 05. Simple Interest

**Competency 5** : Makes successful transactions in the modern world by using percentages.

**Competency Level 5.2** : Makes decisions by calculating the interest.

**Time** : 120 minutes.

### Learning –Teaching Process:

#### Step 1 :

1. Write 20% as a fraction.
2. Find 20% of 500.

Present problems such as the above and lead a discussion by inquiring from the students regarding percentages and interest. During this discussion, highlight the following facts.

- That a percentage is a fraction with denominator equal to 100.
- That the percentage symbol (1%) represents the fraction  $\frac{1}{100}$ .
- That any percentage can be represented as a fraction.
- That when calculating a percentage of a quantity, the quantity should be multiplied by the percentage.
- That interest is the amount paid apart from the capital when money is given on loan or borrowed for a specific period.

(10 minutes)

#### Step 2 :

Engage the students in exploration by using the following leaflet on exploration.

#### Leaflet on Exploration

Two notices issued by two financial institutes are given below.

##### Notice I

Institute A – For every deposit of Rs. 10 000, you will receive an interest of Rs. 1000 at the end of the year.

##### Notice II

Institute B – To those who deposit Rs. 1000, an interest of Rs. 120 will be paid at the end of the year.

Answer the following questions by using the notice received by your group.

- Find the interest received
  - a. at the end of a year
  - b. at the end of two years
 by a person who deposits Rs. 20 000.
- Based on the notice, find the interest obtained at the end of the year by a person who deposits Rs. 100.
- Thereby find the annual interest as a percentage.
- Find the monthly interest as a percentage.
- Find the interest obtained by a person who deposits Rs. 30 000 with a Financial Institute C, which pays an annual interest of 8%.
- Compare the annual interest given by the institute in the above notice, with the annual interest given by Institute C. Explain with reasons which Financial Institute you think gives the better deal.
- If you wish to maximize your income, what are the factors you should take into consideration when you are selecting an institute to deposit money with?
- Prepare to present your answers to the other students in the class.

(80 minutes)

### Step 3 :

After the students' presentations, lead a discussion and highlight the following facts.

- That the annual interest rate is the interest paid in a year for Rs. 100, given as a percentage.
- That this is defined as the annual simple interest rate.
- That when money is deposited in a simple interest scheme the interest paid for a fixed amount is the same for each time period.
- That when calculating the interest under a simple interest scheme,

$$\text{Interest} = \text{Initial Deposit} \times \text{Interest Rate} \times \text{Time}$$

(30 minutes)

### Criteria for Assessment and Evaluation:

- For a given amount, accurately calculates the simple interest received at the end of a year.
- For a given amount, accurately calculates the simple interest received at the end of a given time period.
- When investing an equal amount of money in two institutes, comes to a decision regarding the more advantageous simple interest scheme, by comparing the interest received.
- Uses money wisely in daily life.
- When investing money, selects with reasons, the financial institute that gives the best return.

### 06. Algebraic Expressions I

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

**Competency Level 14.1** : Simplifies expressions by substitution.

**Time** : 100 minutes.

**Learning –Teaching Process:**

**Step 1 :**

$$2(3x - y)$$

Present an algebraic expression of the above form to the class and lead a discussion by simplifying it and substituting values for the unknowns. During the discussion, highlight the following facts.

- That when removing brackets from an algebraic expression, every term within the bracket should be multiplied by the term outside the bracket.
- That the value of the expression can be obtained by substituting values for the unknowns and simplifying.

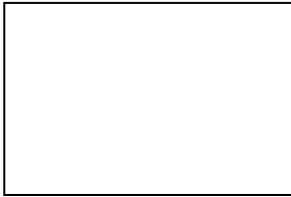
(20 minutes)

**Step 2 :**

Engage the student groups in an activity by using the following leaflet on exploration.

**Leaflet on Exploration**

$x$



$y + 5$

Group	$x$	$y$
A	(i) 3	-4
	(ii) 8.2	-1
B	(i) 2	-1
	(ii) $7\frac{1}{2}$	-2
C	(i) -3	2
	(ii) 8.4	$\frac{2}{3}$
D	(i) 1	-3
	(ii) 12	$-\frac{1}{2}$

- Construct an algebraic expression in terms of  $x$  and  $y$  for the area of the above rectangle.
- Construct an algebraic expression in terms of  $x$  and  $y$  to find the perimeter of the rectangle.
- Find the area and the perimeter of the rectangle by substituting the values your group received for  $x$  and  $y$  in (i).  
Now determine the area and perimeter of the rectangle by substituting the values given in (ii).
- Prepare to present your findings to the class.

(40 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That a value can be obtained for an algebraic expression by substituting positive integers for the unknowns in the expression and simplifying.
- That when simplifying, attention should be paid to the sign of the value that has been substituted.
- That a value can be obtained for an algebraic expression by substituting numbers such as integers, fractions, decimals for the unknowns in the expression and simplifying.

(40 minutes)

**Criteria for Assessment and Evaluation:**

- Substitutes a negative integer into an algebraic expression and simplifies it.
- Substitutes integers into an algebraic expression with brackets and simplifies it.
- Substitutes given values into an algebraic expression and simplifies it.
- Solves problems of various types by working step by step.
- Works with discipline within the group during the activity.

### 06. Algebraic Expressions II

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

**Competency Level 14.2** : Simplifies binomial expressions.

**Time** : 80 minutes.

**Learning –Teaching Process:**

**Step 1 :**

Present several algebraic expressions of the following form to the students and discuss with them regarding the solution that is obtained by removing brackets.

- |   |   |
|---|---|
| <p>(a) 1. <math>5(x + y)</math><br/>         2. <math>5(x - y)</math><br/>         3. <math>-5(x + y)</math><br/>         4. <math>-5(x - y)</math></p> | <p>(b) 1. <math>a(x + y)</math><br/>         2. <math>a(x - y)</math><br/>         3. <math>-a(x + y)</math><br/>         4. <math>-a(x - y)</math></p> |
|---|---|

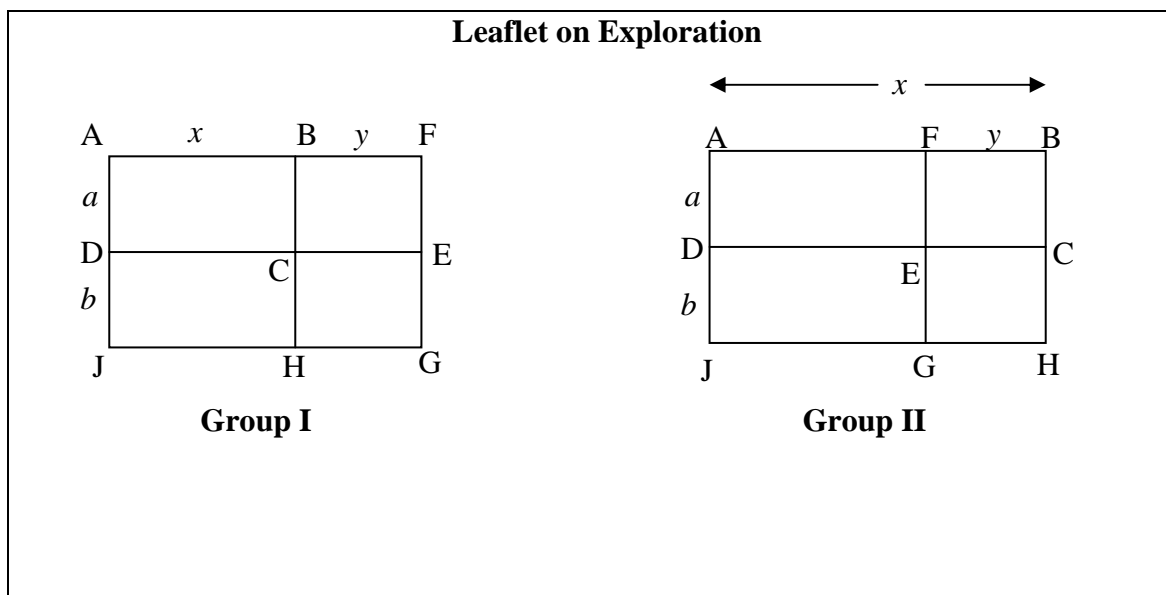
During this discussion, highlight the following fact.

- That when simplifying an algebraic expression with brackets, every term within the brackets should be multiplied by the term outside the bracket.

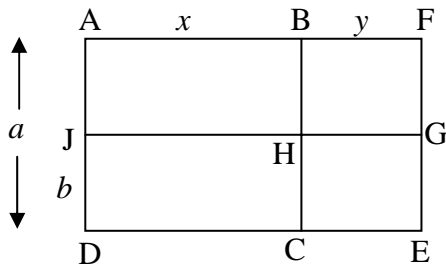
(20 minutes)

**Step 2 :**

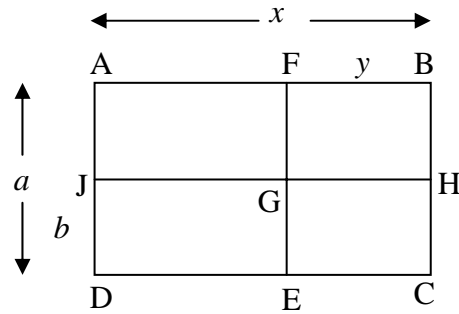
Engage the students in the activity by using the following leaflet on exploration.







**Group III**



**Group IV**

- Select the figure assigned to your group.
- In the figure, ABCD, BCEF, CEGH and DCHJ are rectangles.
- i. Write the length and breadth of the rectangle AFGJ in terms of  $x$  and  $y$ , or  $a$  and  $b$ , and write down an expression for its area.
- ii. In the same manner, write expressions for the area of the rectangles AFED and DEGJ.
- iii. Place an appropriate arithmetic operation in the space provided in the following relationship.  
Area of rectangle AFGJ = Area of rectangle AFED... Area of rectangle DEGJ
- iv. Obtain a relationship by substituting the solutions obtained in (i) and (ii) in the equation in (iii).
- v. By means of the above, write down as a sum of four terms, the solution that is obtained when  $(p + q)(r + s)$  is expanded. Explain how the solution can be obtained by taking products.
- vi. In the equation obtained in (iv),
  - (a) substitute  $b = 2$  and  $y = 3$  and simplify by removing the brackets.
  - (b) substitute  $a = 5$ ,  $b = 2$  and  $y = 3$  and simplify by removing the brackets.
- Prepare to present your findings at the plenary session.

(30 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That the product  $(a + b)(c + d)$  can be obtained by

$$(a + b)(c + d) = a(c + d) + b(c + d) = ac + ad + bc + bd$$

as well as by

$$(a + b)(c + d) = ac + ad + bc + bd$$

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Writes down the steps of multiplying two binomial expressions.
- Multiplies any two binomial expressions and accurately simplifies the product.
- Solves problems by applying the knowledge on finding the product of two binomial expressions.
- Expresses a complex task as a combination of simple tasks.
- Makes complex tasks easier through performing simple tasks.

## 07. Factors of Algebraic Expressions I

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

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

**Time** : 50 minutes.

### Learning –Teaching Process:

#### Step 1 :

Present problems of the following types (as problems to fill in the blanks) which are related to removing common factors from algebraic expressions, and lead a discussion on removing common factors, applying brackets and removing brackets.

$$3x + 6 = 3(\dots + \dots)$$

$$-5x^2 + 10x = -5x (\dots - \dots)$$

$$\dots + \dots = 3x(2x + 4y)$$

During this discussion, highlight the following facts.

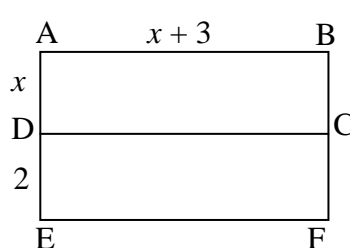
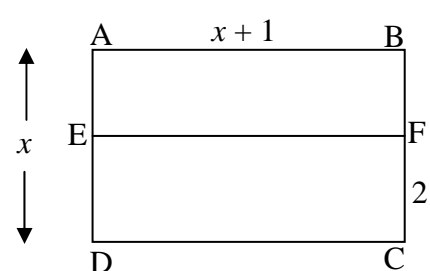
- That the greatest common factor of the terms of an algebraic expression should be found when removing common factors.
- That the terms which should appear within the brackets could be obtained by dividing each term in the expression by the greatest common factor of the terms.
- That by multiplying each term within the brackets by the term outside the bracket, the initial expression can be obtained from the expression from which the common factor has been removed.

(10 minutes)

#### Step 2 :

Engage the students in the activity by using the following leaflet on exploration.

**Leaflet on Exploration**

Group I	Group II
<p><b>Part I</b></p> 	<p><b>Part I</b></p> 
<p><b>Part II</b></p> <ul style="list-style-type: none"> <li>• <math>x(x+2)+5(x+2)</math></li> <li>• <math>2a(a-3)-(a-3)</math></li> <li>• <math>x(2x-1)+5(1-2x)</math></li> <li>• <math>ax-bx+ay-by</math></li> </ul>	<p><b>Part II</b></p> <ul style="list-style-type: none"> <li>• <math>t(t-3)+2(t-3)</math></li> <li>• <math>2m(3m-5)+(3m-5)</math></li> <li>• <math>a(3a-b)-2(b-3a)</math></li> <li>• <math>mn-mt+2n-2t</math></li> </ul>

- Focus your attention on the figure in Part I, assigned to your group.
- Obtain an expression for the area of the rectangle ABCD.
- Obtain an expression for the area of the rectangle CDEF.
- Using the solutions obtained above, construct an expression for the area of the rectangle ABFE
- Construct an expression for the area of the rectangle ABFE by first obtaining an expression for its breadth and then multiplying this by its length.
- Write an equation by equating the two expressions you obtained above for the area of rectangle ABFE.
- Discuss the relationship between the expressions on the two sides of the equation you wrote.
- By considering the relationship you obtained above, write each expression in Part II assigned to your group as a product of two factors.
- Prepare for a presentation at the plenary session.

(20 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That when an algebraic expression with two terms has a binomial expression as a common factor, it can be written as a product of two binomial factors.
- That an expression of the form  $x(x+2) + 5(x+2)$  can be written as a product of two binomial factors.

(20 minutes)

**Criteria for Assessment and Evaluation:**

- When an algebraic expression has been given as a product of two binomial expressions, writes on a figure the length and breadth of a rectangle which has an area equal to the given algebraic expression.
- Writes algebraic expressions of the form  $p(ax+b) + q(ax+b)$  as a product of two binomial expressions.
- Writes an algebraic expression with four terms as a product of two factors by first considering two terms at a time and factoring out the common term.
- Solves day to day life problems easily by developing various relationships.
- Identifies various relationships by performing a task using several methods.

## 07. Factors of Algebraic Expressions II

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

**Competency Level 15.2** : Factorizes quadratic expressions to satisfy mathematical requirements.

**Time** : 60 minutes.

### Learning –Teaching Process:

#### Step 1 :

Lead a discussion on how an expression of the form  $(x+2)(x-3)$  is expanded, on how an expression of the form  $ab+ay+bx+xy$  can be written in the form  $(a+x)(b+y)$  by removing common factors and on how a quadratic term of the form  $6x^2$  is written as a product of a pair of linear factors, and highlight the following facts.

- That an expression of the form  $x^2+bx+c$  is also a quadratic expression.
- That there are quadratic expressions in which either  $b$  or  $c$  or both are zero.
- That some algebraic expressions with four terms can be written as a product of two factors by removing common factors.

(10 minutes)

#### Step 2 :

Engage the groups in an activity by giving each group a single trinomial quadratic expression from those in the following leaflet on exploration.

#### Leaflet on Exploration

- $x^2+5x+6$
- $x^2-5x+6$
- $x^2-x-6$
- $x^2+x-6$

- Focus your attention on the trinomial quadratic expression assigned to your group.
- Multiply the constant term of the expression by the quadratic term and obtain the product.
- Write down all pairs of linear factors of this product.

- Select the pair of linear factors which when added together gives the linear term (middle term) of the original expression.
- Using this pair of linear factors, write the linear term of the trinomial expression as a sum of two terms.
- By using the knowledge you have gained on removing common factors, write the above expression as a product of two factors.
- By following the above procedure, write the trinomial quadratic expression  $y^2 + 8y + 12$  as a product of two factors.
- Prepare to present your findings to the other students in the class.

(30 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That the linear term of a trinomial quadratic expression can be written as a sum of linear factors of the product of the constant term and the quadratic term of the expression.
- That finding the factors of a trinomial quadratic expression is facilitated by writing it as an expression with four terms.
- That a trinomial quadratic expression can be written as a product of two factors.
- That a quadratic expression of the form  $x^2 - a^2$  which is a difference of two squares too can be factored in the above manner

(20 minutes)

**Criteria for Assessment and Evaluation:**

- Finds the factors of a trinomial quadratic expression when it is given as an expression with four terms.
- Writes a given trinomial quadratic expression as a product of a pair of factors by first writing it as an expression with four terms.
- Writes a given trinomial quadratic expression as a product of a pair of factors.
- The group works in cooperation with each other.
- Respects others' opinions.

## 08. Angles related to Straight Lines, Parallel Lines I

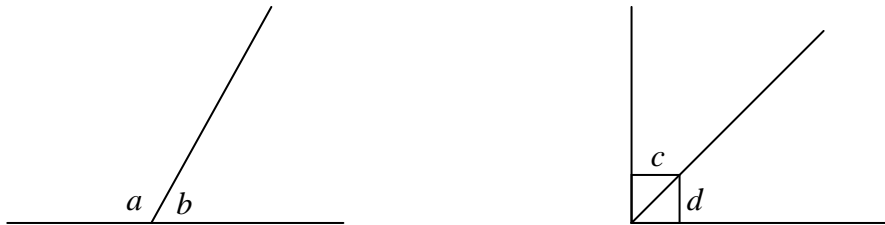
**Competency 21** : Makes decisions by investigating the relationships between various angles.

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

**Time** : 70 minutes.

**Learning –Teaching Process:**

**Step 1 :**



Present figures of the above form to the class and lead a discussion by inquiring from the students regarding complementary adjacent angles and supplementary adjacent angles. During this discussion, highlight the following facts.

- That two angles which have a common vertex and a common arm, and which lie on the two sides of the common arm are defined as adjacent angles.
- That adjacent angles whose sum is  $90^\circ$  are called complementary adjacent angles.
- That adjacent angles whose sum is  $180^\circ$  are called supplementary adjacent angles.
- That adjacent angles on a straight line are supplementary.

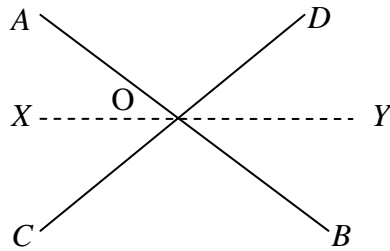
(10 minutes)

**Step 2 :**

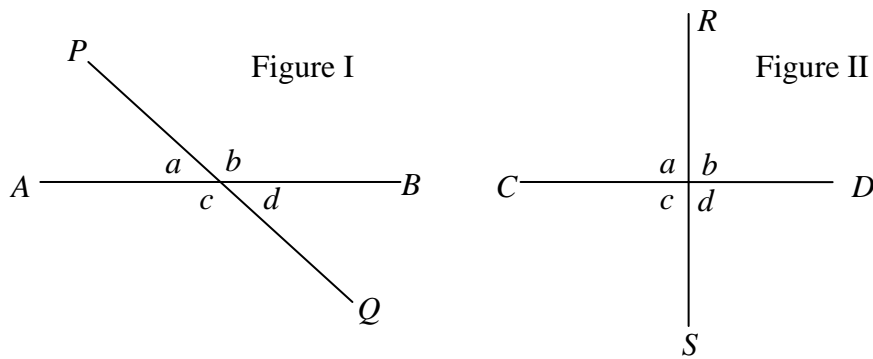
Engage the students in an activity of reaching logical conclusions by using the following leaflet on exploration.

**Leaflet on Exploration**

**Theorem:** The vertically opposite angles formed by two straight lines intersecting each other are equal.



- Draw the above figure on a tissue paper and fold it along the straight line XY so that OD overlaps with OB. What can you say about the angles AOD and COB?



- Consider the figure of two intersecting straight lines which your group received.
- Write an equation in terms of the angles  $a$  and  $b$ .
- Write an equation in terms of the angles  $b$  and  $d$ .
- Using the above two equations, write a relationship between the angles  $a$  and  $d$ .
- In the same manner, write two equations in terms of the angles  $b, d$  and  $c, d$  and obtain a relationship between the angles  $b$  and  $c$ .
- Discuss whether the relationships you obtained agree with the theorem stated above.
- Prepare to present the information you discovered to the others in the class.

(30 minutes)



**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That the vertically opposite angles formed by the intersection of two straight lines are equal.
- That this theorem can be proved formally by considering supplementary adjacent angles.

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Using a figure, explains the result that the vertically opposite angles formed by the intersection of two straight lines are equal.
- Formally proves the theorem that the vertically opposite angles formed by the intersection of two straight lines are equal.
- Solves problems using the theorem on vertically opposite angles.
- Arrives at logical conclusions.
- Makes decisions by following the right steps.

## 08. Angles related to Straight Lines, Parallel Lines II

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

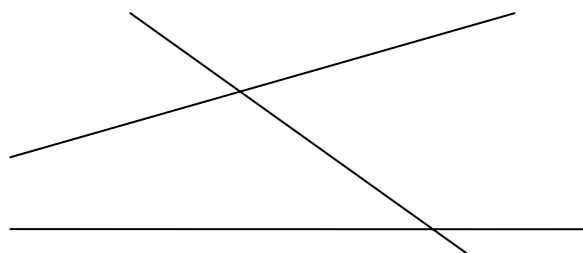
**Competency Level 21.2** : Identifies the relationships between the angles related to parallel lines.

**Time** : 180 minutes.

**Quality Inputs** : A piece of cardboard, a tissue paper, a copy of a protractor.

### Learning –Teaching Process:

#### Step 1 :



Construct the above figure on the board with the involvement of the students. Highlight the following facts by inquiring about the angles in the figure.

- That a straight line which intersects two or more straight lines is called a transversal.
- That angles have been formed with the intersection points as vertices.
- That pairs of angles which form the shape of the letter *Z* or a shape close to it are defined as alternate angles.
- That pairs of angles which form the shape of the letter *F* or a shape close to it are called corresponding angles.
- That pairs of angles formed by the intersection of a transversal with a pair of straight lines, and which lie on one side of the transversal between the two straight lines are defined as allied angles.
- That the magnitude of these angles can be changed by rotating the straight lines through the points of intersection.

(20 minutes)

#### Step 2 :

Engage the student groups in an activity by using Part I of the following leaflet on exploration and the required items.

**Leaflet on Exploration**

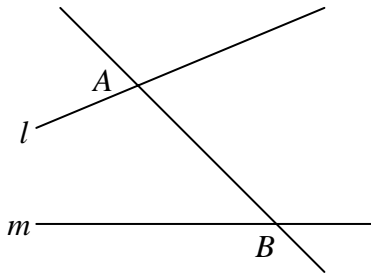
**Part I**

**Theorem**

If the alternate angles formed by the intersection of two straight lines by a transversal are equal, or if the corresponding angles formed are equal or if the allied angles formed are supplementary, then the two straight lines are parallel

**Converse**

If a transversal cuts a pair of parallel lines, then the alternate angles formed are equal, the corresponding angles formed are equal and the allied angles formed are supplementary



	Type of Angle	Relationship between the pair of angles
1	Alternate angles	Equal
2	Corresponding angles	Equal
3	Allied angles	Supplementary

- Copy the above figure on a cardboard and a tissue paper.
- On the figure, mark a pair of angles of the type relevant to your group.
- Measure the magnitude of the angle that you marked at point B and note it down.
- Place the given copy of the protractor on the figure drawn on the cardboard and over it place the tissue paper so that the two figures with the straight lines overlap and attach them all together at point A using a pin.
- Rotate the line  $l$  on the tissue paper until you obtain the given relationship between the pair of angles.
- Name this line as  $l_1$  and examine whether  $l_1$  and  $m$  are parallel.
- Thereby examine whether the above theorem is true.
- Prepare to present the information you discovered to the others in the class.

(40 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That when pairs of alternate angles are equal, the related lines are parallel.
- That when pairs of corresponding angles are equal, the related lines are parallel.
- That when pairs of allied angles are supplementary, the related lines are parallel.
- That the theorem is verifiable.
- That therefore, the converse is also true.

(40 minutes)

**Step 4 :**

Engage the student groups again in an activity by using Part II of the leaflet on exploration.

**Part II**

	1	2	3
Figure 1			
Figure 2	<p>Are <i>PQ</i> and <i>RS</i> parallel if <math>a = 55^\circ</math> and <math>b = 33^\circ</math>?</p>	<p>Find <math>a, b</math> and <math>c</math></p>	<p>Find <math>a, b</math> and <math>c</math></p>

- Focus your attention on the two figures relevant to your group.
- Find the magnitude of the angles  $a, b, c, d, e, f$  and  $g$  in the first figure in the given order. Provide reasons for your answers.
- For case (1) of figure 2 determine the answer, and for cases (2) and (3) find the magnitude of the angles  $a, b$  and  $c$ . Provide reasons for your answers.
- Prepare for a presentation at the plenary session.

(40 minutes)

**Step 5 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That the magnitude of angles in a geometric plane figure can be determined using the relationships between pairs of alternate angles, corresponding angles and allied angles.
- That both the theorem and its converse are applied when making deductions.
- That deduction is a process of steps that are carried out with reasons.
- That when stating the relationships between pairs of alternate angles, corresponding angles or allied angles as reasons, the relevant lines should also be mentioned.

(40 minutes)

**Criteria for Assessment and Evaluation:**

- Expresses the theorem and its converse accurately.
- Uses the relationships between alternate angles, corresponding angles and allied angles when deducing the magnitude of angles of a geometric plane figure using given magnitudes of related angles.
- Applies the theorem as well as its converse to solve simple geometry problem.
- Obtains meaningful results by working cooperatively.
- Uses verifications to explain special situations.

## 09. Liquid Measurements

**Competency 11** : Fulfills daily needs by working critically with the knowledge of liquid measures.

**Competency Level 11.1** : Develops relationships between the various units of liquid measures.

**Time** : 60 minutes.

**Quality Inputs** : Vessels that have been calibrated in ml and  $\text{cm}^3$ .

### Learning –Teaching Process:

#### Step 1 :

Present figures of cubes with sides of length 5cm and 100cm respectively, vessels calibrated in ml as well as vessels calibrated in  $\text{cm}^3$ , and lead a discussion regarding how the volume of a cube is found, regarding volume and capacity and regarding the relationship between ml and  $l$ .

During this discussion, highlight the following facts.

- That the volume of a cube with sides of length  $a$  is given by  $a^3$ .
- The ml is a unit used to measure liquid volume.
- That  $\text{cm}^3$  and  $\text{m}^3$  are also units that are used to measure liquid volume.
- That the volume of a cube with sides of length 100cm (1m) is  $1 \text{ m}^3$ .
- That  $1000\text{ml} = 1l$ .
- That the amount of liquid required to completely fill a vessel is the capacity of the vessel.

(10 minutes)

#### Step 2 :

Engage the students in an activity of identifying relationships by using the following leaflet on exploration.

#### Leaflet on Exploration

- Pour equal amounts of water into the two vessels calibrated in  $\text{cm}^3$  and ml, which have been given to your group, and note down the readings separately.
- Use different amounts of water and as in the above case, obtain the readings for three different cases and separately note down the readings obtained from the two calibrated vessels.
- Develop a relationship between  $\text{cm}^3$  and ml based on the readings obtained from the two vessels.
- Focus your attention on the figure that your group received from the following cube shaped figures.

Group	A	B
Cube		
Units of Measurement	$\text{cm}^3$ and $l$	$\text{m}^3$ and $l$
Conversion	$2000 \text{ cm}^3 = \text{-----} l$ $\text{-----} \text{ cm}^3 = 1.5l$	$2 \text{ m}^3 = \text{-----} l$ $\text{-----} \text{ m}^3 = 3500 l$

- Find the capacity of the cube shaped vessel in  $\text{cm}^3$ .
- By applying the results obtained above, develop a relationship between the two units of measurement received by your group.
- Fill in the blanks in the given conversions by using the relationship you developed.
- Engage in the above process for the case given to the other group too.
- Prepare to present your group's findings.

(30 minutes)

**Step 3 :**

After the groups' presentations, lead a discussion and highlight the following facts.

- That  $1\text{cm}^3 = 1\text{ml}$
- That  $1000\text{cm}^3 = 1l$
- That  $1000l = 1\text{m}^3$
- That the above relationships are used in calculations related to liquid measurements.

(20 minutes)

**Criteria for Assessment and Evaluation:**

- Performs conversions using the relationship between  $\text{cm}^3$  and  $\text{ml}$ .
- Performs conversions using the relationship between  $\text{cm}^3$  and  $l$ .
- Converts liquid measurement units using the relationships between  $\text{cm}^3$ ,  $\text{ml}$ ,  $l$  and  $\text{m}^3$ .
- Develops various relationships through analysis.
- Considers others' opinions when performing tasks.

## 10. Direct Proportions

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

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

**Time** :120 minutes.

### Learning –Teaching Process:

#### Step 1 :

Discuss with the students regarding how the price of 5 exercise books can be found if the price of four exercise books is Rs. 80.00. During this discussion, highlight the following facts.

- That if the price of several units of the same kind of item is given, by finding the price of one unit, the price of any number of the same item could be found.
- That this method of finding the price of one unit is called the unitary method.
- That the price of several units can also be found in the form ‘if 4 : 80, then 5 : ?’
- That finding a value using ratios is called the proportional method.
- That when the number of units increases the total price increases correspondingly.

(20 minutes)

#### Step 2 :

Engage the students in an analytical study by using the following leaflet on exploration.

#### Leaflet on Exploration

Focus your attention on the following information.

- The price of 5 pencils is Rs. 50.
- The price of 2 pencils is Rs. 20.

Groups I and II	Unitary Method
Groups III and IV	Proportional Method

- Explain how the price of 10 pencils is found using the method received by your group.
- Based on the above information, develop a relationship between the number of pencils and the total cost of the pencils.
- Obtain two ordered pairs to graph this relationship.
- Draw the graph of this relationship on a graph paper and explain how the price of 10 pencils can be found using the graph.
- Discuss the advantages and disadvantages of the first method as well as the graphical method you used to find the price.



**The price of a sterling pound is Rs. 160.00**

- Discuss how the graphical method can be used to find the value of a given amount of pounds in rupees, for the above exchange rate. Draw the graph for the above exchange rate and find the value of £2, £5 and £10 in Sri Lankan rupees.
- Prepare to present the information you discovered to the class.

(60 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That a proportion is a statement of equality between two ratios.
- That two variables are said to be in direct proportion if when one variable increases, the other also increases such that the ratio between the two is a constant.
- That direct proportion problems can be solved using the unitary method.
- That direct proportion problems can also be solved using ratios.
- That when a direct proportion relationship is graphed, a straight line of the form  $y = mx$  where  $m$  is positive is obtained.
- That direct proportion problems can be solved easily using graphs.

(40 minutes)

**Criteria for Assessment and Evaluation:**

- Finds the value of one unit accurately when the value of several units of an item is given.
- Finds the value of a given number of units accurately when the value of several units of an item is given.
- Recognizes direct proportions and solves problems using them.
- Makes correct financial transactions in real life situations.
- Gathers information on foreign transactions.

## 11. Calculator

**Competency 6** : Easily solves mathematical problems in day to day life by using logarithms and calculators.

**Competency Level 6.3** : Uses calculators to facilitate calculations.

**Time** : 90 minutes.

### Learning –Teaching Process:

#### Step 1 :

Provide the students with calculators and let them observe the keys.

Lead a discussion based on it and highlight the following facts.

- That it is necessary to identify the order in which the keys of the calculator should be used when performing calculations involving the 4 basic mathematical operations.
- That the key **ON** provides power to the calculator.
- That power is cut off by the key **OFF** and that the screen is cleared by this.
- That the last operation/value is erased by the key **CE**.
- That the result of a mathematical operation is given by the key **=**.

(20 minutes)

#### Step 2 :

Engage the students in the activity by using the following leaflet on exploration.

#### Leaflet on Exploration

Let us find the percentage of the marks that 3 students obtained for three subjects. Saman $\frac{35}{50}$ Kamal $\frac{17}{20}$ Ruvan $\frac{13}{25}$	Let us find the area of three square plots of land when the length of a side is given. Plot A – 12 m Plot B – 2.5 m Plot C – 3.6 m	Let us find the length of a side of three square plots of land when the area is given. D – 169 m <sup>2</sup> E – 256 m <sup>2</sup> F – 196 m <sup>2</sup>
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- Carefully study the case received by your group.
- By using the normal method of calculation obtain the solution to the problems you received.
- Determine whether your solutions are correct, by using the scientific calculator you are provided with.

- In a flow chart, present the steps you performed to obtain the solution by using the calculator.
- Discuss the advantages as well as the disadvantages of performing simplifications by using a calculator.
- Prepare to present your findings at the plenary session.

(40 minutes)

**Step 3 :**

After the students' presentations of their findings, lead a discussion and highlight the following facts.

- That a calculator can be used to determine the accuracy of a calculation which has been performed.
- That how the keys =, %,  $x^2$  and  $\sqrt{x}$  are used should be recognized.
- That when using a calculator, the order in which the steps are performed is important.
- That calculations can be performed easily with the aid of a calculator.
- That although a calculator facilitates calculations, a simple error in one step could result in a wrong answer being obtained.

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Determines which keys in the calculator should be used to obtain the solution to a problem.
- Represents by a flow chart, the order in which the keys of a calculator are used to obtain the solution to a problem.
- Uses a calculator to determine whether the solution obtained by performing a calculation is accurate.
- Works towards obtaining the most accurate solution.
- Works efficiently.

## 12. Indices and Logarithms I

**Competency 6** : Easily solves mathematical problems in day to day life by using logarithms and calculators.

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

**Time** :100 minutes.

### Learning –Teaching Process:

#### Step 1 :

Lead a discussion on representing a number as a power and on simplifying integers. During this discussion, highlight the following facts.

- That a positive number is obtained as the solution when two integers with the same sign are multiplied or divided.
- That a negative number is obtained as the solution when two integers with opposite signs are multiplied or divided.
- That a repeated product of a number can be represented as a power.
- That in a power of the form  $a^3$ ,  $a$  is defined as the base and 3 is defined as the index.

(10 minutes)

#### Step 2 :

Engage the students in an analytical study by using the following leaflet on exploration.

<b>Leaflet on Exploration</b>					
<b>Part I</b>			<b>Part II</b>		
<b>A</b>	$\frac{2^5}{2^3}$	$\frac{a^8}{a^5}$	<b>A</b>	$\frac{2^5}{2^5}$	$\frac{3^3}{3^5}$
<b>B</b>	$3^3 \times 3^4$	$a^5 \times a^4$	<b>B</b>	$\frac{x^6}{x^6}$	$\frac{x^5}{x^8}$
<b>C</b>	$(3^2)^3$	$(x^3)^4$	<b>C</b>	$\frac{(3^2)^3}{(3^3)^2}$	$\frac{(x^2)^4}{(x^3)^4}$

- Focus your attention on the problems in Part I received by your group.
- Expand the powers in them, simplify and then write the solution as a power.
- To facilitate simplification, propose another method which does not include expansion.
- Write several other similar problems and see whether the method you proposed can be used to simplify them.

- Solve the problems given in Part II and obtain their solutions.
- Based on the solutions, what can be said about powers with index zero?
- Is this true for all powers with index zero?
- Can a power with a negative index be written as a power with a positive index? If yes, how can this be done?
- Prepare to present your group's findings to the class.

(60 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That when powers with the same base are multiplied, the indices are added together.
- That when powers with the same base are divided, the index of the denominator is subtracted from the index of the numerator.
- That the value of a power with index zero is 1 ( $a^0 = 1$ ,  $a \neq 0$ ).
- That a power with a positive index is the reciprocal of a power with a negative index.

That is,  $a^n = \frac{1}{a^{-n}}$

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Multiplies powers with the same base.
- Simplifies powers with positive indices using the laws of indices.
- Simplifies powers with positive as well as negative indices.
- Tries out various easy methods to perform different tasks.
- Works with discipline.

## 12. Indices and Logarithms II

**Competency 6** : Easily solves mathematical problems in day to day life by using logarithms and calculators.

**Competency Level 6.2** : Develops the relationship between indices and logarithms and writes powers as logarithms and logarithms as powers.

**Time** : 60 minutes.

### Learning –Teaching Process:

#### Step 1 :

Recall students' knowledge on writing a number as a power, and lead a discussion so that the following facts are highlighted.

- That when a number is written as a power, the index represents the number of times the base is repeatedly multiplied to give the relevant number.
- That an expression which is represented as a power consists of two components.

- That  $2^3$   $\left\{ \begin{array}{l} \leftarrow \text{index} \\ \leftarrow \text{base} \end{array} \right\}$  power

(10 minutes)

#### Step 2 :

Engage the students in the activity by using the following leaflet on exploration.

#### Leaflet on Exploration

##### NOTE

- When a number is written as a power, the index is defined as the logarithm of the number to the given base.
- This is represented by 'log' and the base is written after it as a subscript.

$$16 = 4^2$$

$$\log_4 16 = 2$$

$$16 = 2^4$$

$$\log_2 16 = 4$$

1	2	3	4
$32 = 2^5$	$\log_3 81 = 4$	$125 = 5^3$	$\log_2 64 = 6$

- Focus your attention on the expression received by your group.

- Depending on the expression that has been received, convert and present an expression with indices in logarithmic form and an expression with logarithms in index form (use the given note).
- Write  $N = a^x$  in logarithmic form.
- Write  $\log_3 243 = 5$  in index form.
- Discuss why different values can be obtained for the logarithm of a number, as given in the above note.
- Prepare to present your group's findings at the plenary session

(30 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That an expression in index form can be written in logarithmic form.
- That if  $N = a^x$ , then  $\log_a N = x$ .
- That if  $\log_a N = x$ , then  $N = a^x$ .
- That expressions in logarithmic form can be converted to index form.
- That when a number is written as a power with a given base, the index is the logarithm of the number in the given base.

(20 minutes)

**Criteria for Assessment and Evaluation:**

- Explains what the logarithm of a number is.
- Represents expressions given in logarithmic form, in index form.
- Writes a given number as a logarithm under different bases.
- Respects others' ideas.
- Develops the ability to work as a team.

### 13. Constructions I

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

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

**Time** : 70 minutes.

**Learning –Teaching Process:**

**Step 1 :**



Present the above picture to the class and lead a discussion by inquiring about the 4 basic types of loci. During this discussion, highlight the following facts.

- That the path of a point which travels at a constant distance from a fixed point is a circle.
- That the path of a point which travels at an equal distance from two fixed points is the perpendicular bisector of the straight line that joins the two points.
- That the path of a point which travels at a constant distance from a fixed straight line is one or the other of two straight lines parallel to the fixed straight line and lying on either side of it.
- That the path of a point which travels at an equal distance from two intersecting straight lines is the bisector of the angle between the two intersecting lines.

(10 minutes)

**Step 2 :**

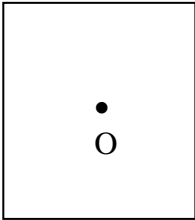
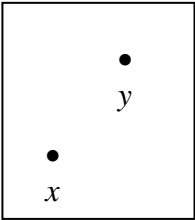
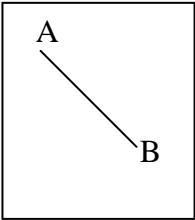
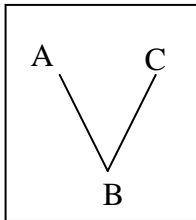
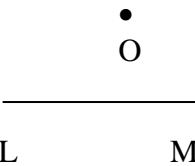
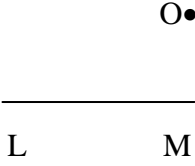
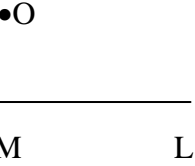
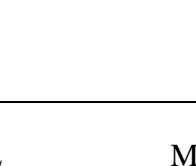
Engage the groups in an activity by using the following leaflet on exploration.



**Leaflet on Exploration**

**Part I**

- Focus your attention on the construction received by your group. Discuss about the geometrical features of the construction.

	Group 1	Group 2	Group 3	Group 4
Task I	 <p>The path of a point which travels a constant distance of 6cm from the fixed point O</p>	 <p>The path of a point which travels at an equal distance from the points x and y</p>	 <p>The path of a point which travels a constant distance of 3cm from the straight line AB</p>	 <p>The path of a point which travels an equal distance from the two straight lines AB and BC</p>
Task II				

- Using a straight edge and compass, and considering the given properties, mark several points on the locus that your group received under Task I.
- Discuss how the line (straight or curved) which joins these points can be constructed using only a straight edge and compass.
- Construct the given path accordingly.
- Propose a suitable name for the path you constructed.

**Part II**

- On the straight line LM in Task II or on LM extended, mark two points which are at an equal distance from point O. Use the compass to do this.
- Mark a point which is at an equal distance from these two points but which lies on the side opposite to the side on which O lies with respect to LM. Name it P.
- Draw the straight line which joins the points O and P.
- Examine whether the angles that are formed by the intersection of the lines OP and LM are right angles.

- Based on this, discuss the method of constructing a perpendicular from O to LM.
- Draw any straight line, mark a point external to it and draw a perpendicular from the point to the straight line.
- Prepare to present your discoveries at the plenary session.

(40 minutes)

### Step 3 :

After the students' presentations, lead a discussion and highlight the following facts.

- That the fixed point relevant to the locus of the points which are at a constant distance from the fixed point is the centre of the circle which is the locus of the points.
- That the distance from the fixed point to any point on the circle is equal, and that this fixed distance is defined as the radius of the circle.
- That the locus of the points which are at an equal distance from two fixed points is obtained from the construction of the perpendicular bisector of the straight line that joins the two points.
- That the locus of the points which are at a constant distance from a fixed straight line is obtained from the construction of the two parallel lines which are at the constant distance from the fixed straight line and which lie on its two sides.
- That the locus of the points which are at an equal distance from two intersecting straight lines is obtained by constructing the bisector of the angle at the point of intersection.
- That a perpendicular from an external point to a straight line can be constructed by marking on the straight line, two points which are at an equal distance from the external point.

(20 minutes)

### Criteria for Assessment and Evaluation:

- Describes the four basic loci.
- Constructs the four basic loci using a straight edge and a compass.
- Solves problems by applying the four basic loci appropriately.
- Uses constructions in daily tasks.
- Does constructions according to given conditions.

### 13. Constructions II

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

**Competency Level 27.2** : Uses geometric constructions in various activities.

**Time** : 100 minutes.

#### Learning –Teaching Process:

##### Step 1 :

Present a figure of adjacent angles on a straight line as well as equilateral triangles and lead a discussion on them. During this discussion, highlight the following facts.

- That the sum of the adjacent angles on a straight line is  $180^\circ$ .
- That the sum of the angles about a point is  $360^\circ$ .
- That the interior angles of an equilateral triangle are all equal to each other.
- That accordingly each angle equals  $60^\circ$ .

(10 minutes)

##### Step 2 :

Engage the students in a creative activity by using the following leaflet on exploration.

#### Leaflet on Exploration

Group	Angle
1	$120^\circ$
2	$90^\circ$
3	$30^\circ$
4	$45^\circ$

- Draw a semi-circle with radius about 6cm.
- Taking this same radius, divide the arc of the semi-circle into equal parts with the aid of a compass. Into how many parts is the semi-circle divided?
- Measure the angles of all the sectors that are formed. What is the magnitude of the angle that can be constructed by this method?
- Now focus your attention on the angle that your group has been provided with.
- Discuss how the angle your group obtained can be constructed using the angle you constructed earlier.
- Construct the given angle.
- What are the other angles that you can construct in the above manner without using the protractor?
- Construct two such angles.

- Discuss how a given angle can be copied in another place by drawing an arc of a circle with centre the vertex of the angle.
- Draw any angle you like and with the aid of the compass, make a copy of the angle in another place.
- Using a protractor, measure the magnitude of the two angles and see whether they are equal.
- Prepare to present your group's findings creatively at the plenary session.

(60 minutes)

### Step 3 :

After the students' presentations, lead a discussion and highlight the following facts.

- That an angle of  $60^\circ$  can be constructed using an equilateral triangle.
- That an angle of  $60^\circ$  can be constructed by dividing the arc of a semi-circle into three equal parts.
- That an angle of  $60^\circ$  can be used to construct angles which are of magnitude a multiple of it.
- That angles of  $15^\circ$ ,  $30^\circ$ ,  $45^\circ$  and  $90^\circ$  can be constructed by bisecting angles.

(30 minutes)

### Criteria for Assessment and Evaluation:

- Constructs angles of  $60^\circ$  and  $90^\circ$ .
- Constructs an angle of  $15^\circ$  and its multiples with the aid of a compass and a straight edge.
- When solving problems, constructs angles of magnitude a multiple of  $15^\circ$ , and copies angles.
- Does constructions based on given information.
- Focuses on doing new constructions.

## 14. Equations I

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

**Competency Level 17.1** : Easily solves the problems in daily life by solving simple equations.

**Time** : 60 minutes.

### Learning –Teaching Process:

#### Step 1 :

Highlight the following facts by leading a discussion and inquiring about removing brackets from algebraic expressions of the form  $2(a + 1)$ ,  $5 - (a - 1)$  as well as about adding numerical fractions.

- That to remove brackets from an algebraic expression with brackets, every term within the brackets should be multiplied by the number outside the brackets.
- That when there is no number outside the brackets which enclose an expression, every term within the brackets should be multiplied by +1 or -1 according to whether the sign outside is plus or minus.
- That when solving a simple equation containing an unknown with a fractional coefficient, to convert the coefficient into a whole number, all the terms in the equation should be multiplied by the denominator of the fraction.

(10 minutes)

#### Step 2 :

Engage the students in the activity by using the following leaflet on exploration.

<b>Leaflet on Exploration</b>		
	<b>Part I</b>	<b>Part II</b>
i	$2\{2(x + 1) + 1\} + 3x = 13$	$\frac{1}{2}(x + 1) + 7 = 10$
ii	$3\{2(x - 3) - 1\} - 2x = 3$	$\frac{1}{3}x + \frac{1}{2}(x + 1) = 3$
iii	$2\{2(x + 4) + 2\} - x = 2$	$\frac{1}{4}(x + 1) + \frac{1}{5}(x + 3) = 4$
iv	$2\{3(5 + 3x) - 1\} - 5x = 2$	$\frac{1}{6}x + \frac{1}{4}(x - 1) = 1$

• Focus your attention on the pair of equations received by your group.

- Remove the brackets from the equation in Part I.
- Remove the denominators in the equation in Part II.
- Obtain the solution of each of the equations by using your knowledge on solving equations.
- Use your knowledge on substitution to determine whether your solutions are correct.
- Prepare to present your group's findings at the plenary session.

(30 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That when solving a simple equation with two sets of brackets, all the terms within each pair of brackets should be multiplied by the number outside.
- That when solving a simple equation with fractional coefficients and brackets, the fractional coefficients should be converted into whole numbers by multiplying all the terms by the least common multiple of the denominators.
- That the value of the unknown can be found by solving the simple equation that is obtained after the brackets are removed.

(20 minutes)

**Criteria for Assessment and Evaluation:**

- Accurately solves a simple equation with brackets.
- Accurately solves and determines the answer to a simple equation with fractional coefficients and brackets.
- Applies the knowledge on solving simple equations to solve problems in day to day life.
- Accurately manipulates appropriate methods to solve problems.
- Uses one's experience to solve problems in day to day life.

## 14. Equations II

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

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

**Time** : 80 minutes.

### Learning –Teaching Process:

#### Step 1 :

Discuss with the students regarding how simple equations of the form  $x + 3 = 5$  and  $3x + 5 = 14$  are solved as well as regarding equations of the form  $x + y = 2$ . During this discussion, highlight the following facts.

- That a simple equation contains exactly one unknown.
- That by solving a simple equation, a numerical value can be obtained for the unknown.
- That an infinite number of solution pairs can be obtained for the pair of unknowns in an equation with two unknowns.
- That by solving a pair of equations with two unknowns, the values of the unknowns can be obtained.
- That such a pair of equations is called simultaneous equations.

(10 minutes)

#### Step 2 :

Engage the students in the activity by using the following leaflet on exploration.

#### Leaflet on Exploration

$x + y = 5$ $2x - y = 4$	$2x + 5y = 13$ $3x - 5y = 7$
$5x + y = 20$ $4x + y = 17$	$2x + 3y = 14$ $5x + 3y = 26$

- Focus your attention on the pair of simultaneous equations received by your group.
- Obtain a simple equation by either adding or subtracting the pair of equations.
- Now solve the simple equation you obtained and find the value of the unknown.

- Substitute this value into one of the equations from the pair which your group received and find the value of the other unknown.
- Examine the accuracy of the solution you obtained by substituting the values back into the equations.
- Propose another method that can be used to solve the given pair of equations.
- Prepare to present your group's findings at the plenary session.

(40 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That solving a pair of simultaneous equations is made easier by first eliminating the unknown which has the same coefficient in both equations.
- That to eliminate an unknown when the magnitude of the coefficient of the unknown is the same in both equations, the equations have to be added if the sign of the coefficient is unequal in the two equations.
- That to eliminate an unknown when the magnitude as well as the sign of the coefficient of the unknown is the same in both equations, one equation has to be subtracted from the other.
- That the accuracy of the solutions may be examined by substituting the values obtained for the unknowns back into the equations.

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Describes the method of solving a given pair of simultaneous equations, by considering the sign of the coefficients of the unknowns.
- Solves a pair of simultaneous equations when the sign of the coefficient of one unknown is unequal in the two equations, but the magnitude of the coefficient is the same.
- Solves any pair of simultaneous equations in which the magnitude of the coefficient of one unknown is equal in both equations.
- Uses various methods to solve problems.
- Manipulates information to reach correct conclusions.



### 15. Angles of a Triangle I

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

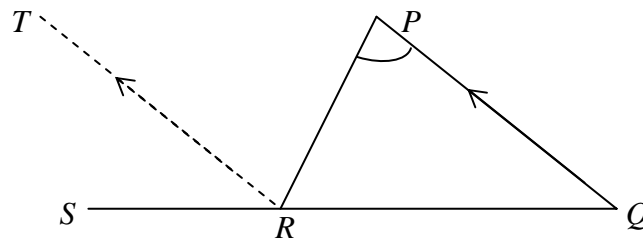
**Competency Level 23.1** : Formally finds the sum of the three interior angles of a triangle.

**Time** : 60 minutes.

**Learning –Teaching Process:**

**Step 1 :**

Present the following figure to the class and lead a discussion regarding the angles on a straight line and the angles related to parallel lines.



During this discussion, highlight the following facts.

- That the magnitude of a straight angle is  $180^\circ$ .
- That the alternate angles and the corresponding angles formed by a transversal cutting a pair of parallel lines are equal.
- That quantities which are equal to a given quantity are equal to each other.

(10 minutes)

**Step 2 :**

Engage the students in an analytical study by using the following leaflet on exploration.

**Leaflet on Exploration**

**Theorem:** The sum of the interior angles of a triangle equals  $180^\circ$

- Consider the figure received by your group from the following figures.

Figure I

Figure II

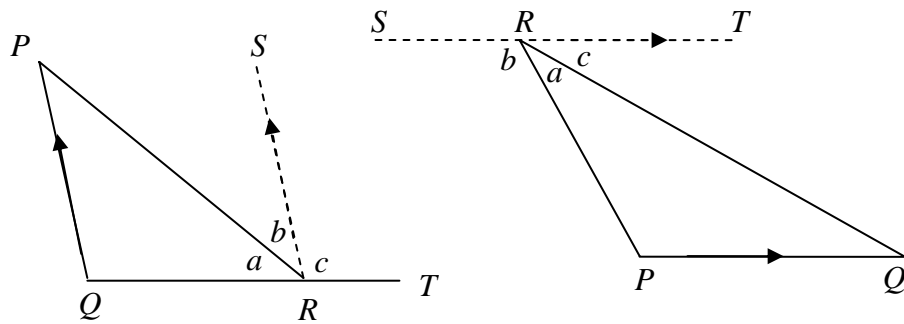


Figure III

Figure IV

- Write down an equation in terms of  $a, b, c$  for the sum of the three angles at point  $R$  and name the equation (1).
- Name an angle in the triangle which is equal to  $c$ .
- Name an angle in the triangle which is equal to  $b$ .
- Obtain an equation for the sum of the interior angles of the triangle by substituting the angles of the triangle which are equal to  $c$  and  $b$ , into equation (1).
- Discuss whether the relationship you obtained agrees with the above mentioned theorem.
- Write down the formal proof of the above theorem based on the activity you carried out.
- Prepare to present your group's findings to the others in the class.

(30 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That the sum of the interior angles of a triangle equals  $180^\circ$ .
- That the above theorem can be proved formally by constructing a line parallel to one side of the triangle through the opposite vertex of the triangle and using the knowledge on the angles related to parallel lines.
- That problems can be solved by using the above theorem.

(20 minutes)

**Criteria for Assessment and Evaluation:**

- Verifies that the sum of the interior angles of a triangle equals  $180^\circ$ .
- Formally proves the theorem that the sum of the interior angles of a triangle equals  $180^\circ$ .
- Solves problems by applying the fact that the sum of the interior angles of a triangle equals  $180^\circ$ .
- Reaches conclusions by thinking logically.
- Develops new concepts which are based on logical relationships.

## 15. Angles of a Triangle II

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

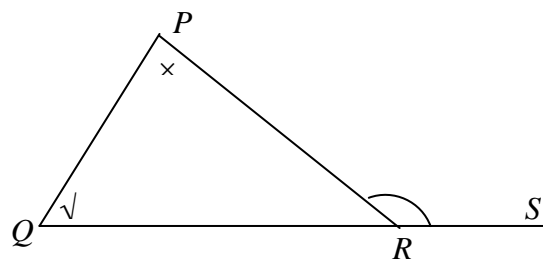
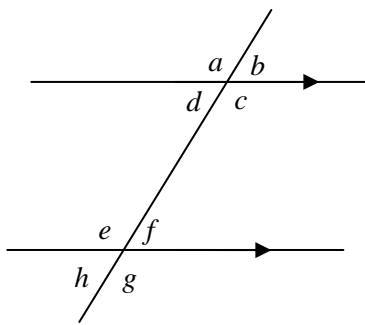
**Competency Level 23.2** : Examines the relationship between the exterior angle and the two interior opposite angles of a triangle.

**Time** : 80 minutes.

### Learning –Teaching Process:

#### Step 1 :

Present the following figures to the class.



With the aid of the above figures lead a discussion and highlight the following facts.

- That since the corresponding angles are equal to each other  $a = e$ ,  $b = f$ ,  $d = h$  and  $c = g$ .
- That since the alternate angles are equal to each other,  $d = f$  and  $c = e$ .
- That  $\widehat{PRS}$  is the exterior angle that is formed by producing the side  $QR$  of the triangle  $PQR$ .
- That  $\widehat{PQR}$  and  $\widehat{QPR}$  are the two interior opposite angles of the exterior angle  $\widehat{PRS}$ .

(10 minutes)

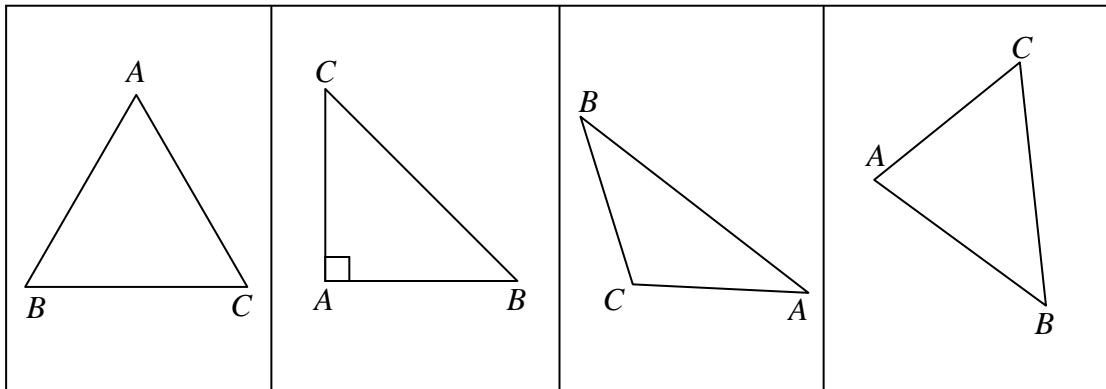
#### Step 2 :

Engage the students in an analytical study by using the following leaflet on exploration.

### Leaflet on Exploration

**Theorem:** If a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles

- Carefully study the above theorem.



- Focus your attention on the triangle received by your group.
- Produce the side AB of the triangle up to the point D.
- Name the exterior angle you obtain.
- Name the two interior opposite angles of this exterior angle.
- Draw BE through the point B such that it is parallel to AC.
- Name the two angles that the exterior angle is divided into by the line BE.
- Name the two interior angles which are equal to the above two angles, by considering corresponding angles and alternate angles related to parallel lines.
- Accordingly, propose a method to prove that the above theorem is true in general.
- Prepare for a presentation at the plenary session.

(40 minutes)

### Step 3 :

After the students' presentations, lead a discussion and highlight the following facts.

- That when a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles.
- That the above theorem can be proved formally by using the properties of corresponding angles and alternate angles related to parallel lines.

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Explains using figures that when a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles.
- Formally proves the theorem that when a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles.
- Solves problems by applying the theorem that when a side of a triangle is produced, the exterior angle so formed is equal to the sum of the two interior opposite angles.
- Uses one's experience in complex situations.
- Thinks logically when making decisions.

### 16. Formulae

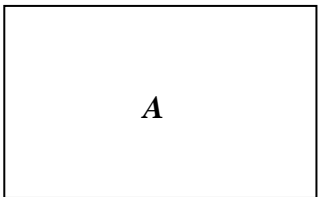
**Competency 19** : Solves problems encountered in day to day life by exploring the methods by which formulae can be applied.

**Competency Level 19.1** : Changes the subject of formulae that have been constructed to indicate the relationships between variables.

**Time** : 60 minutes.

**Learning –Teaching Process:**

**Step 1 :**



$l$

$A$

$b$

If the area of a rectangle of length  $l$  and breadth  $b$  is  $A$ , then  $A = lb$

Present a formula of the above form as well as a step by step solution to a simple equation and lead a discussion so that the following facts are highlighted.

- That the single term on one side of an algebraic relationship given in equation form which has been constructed such that it is applicable in general, is called the subject.
- That it is necessary to change the subject depending on the situation.
- That simple equations can be solved using flow charts.

(10 minutes)

**Step 2 :**

Engage the students in an activity of discovery through performing the given steps of the following leaflet on exploration.

**Leaflet on Exploration**

- Focus your attention on the formula received by your group from the formulae in Part I below, as well as on the set of cards assigned to your group.

<b>Part I</b>	$v = u + ft \quad (t)$	$T = a + (n - 1)d \quad (n)$	$S = ut + \frac{1}{2}ft^2 \quad (f)$
<b>Part II</b>	$A = 2\pi rh + a \quad (h)$	$S = \frac{n}{2}(a + l) \quad (a)$	$V = I(R + r) \quad (r)$

Set I	Set 2	Set 3
$v = u + ft$ $\frac{v-u}{f} = t$ $v - u = u + ft - u$ $\frac{v-u}{f} = \frac{ft}{f}$ $v - u = ft$	$T = a + (n-1)d$ $\frac{T-a}{d} = n-1$ $\frac{T-a}{d} + 1 = n$ $T - a = a + (n-1)d - a$ $\frac{T-a}{d} = \frac{(n-1)d}{d}$ $T - a = (n-1)d$ $\frac{T-a}{d} + 1 = n - 1 + 1$	$S = ut + \frac{1}{2} ft^2$ $S - ut = \frac{1}{2} ft^2$ $2(S - ut) = ft^2$ $2 \frac{(S - ut)}{t^2} = f$ $2(S - ut) = 2 \times \frac{1}{2} ft^2$ $S - ut = ut + \frac{1}{2} ft^2 - ut$ $2 \frac{(S - ut)}{t^2} = \frac{ft^2}{t^2}$

- Carefully observe the steps in the set of cards received by your group.
- Follow the method of solving an algebraic equation using a flow chart and organize the cards in order. Thereby discuss the steps of changing the subject of the formula to the unknown given in brackets in part I.
- On the piece of paper provided to you, write down the steps you discovered in the correct order.
- Using this as a guide, write down the steps that should be performed to change the subject of the formula in Part II to the unknown given in brackets.
- Prepare to present your findings at the plenary session.

(30 minutes)

**Step 3 :**

After the students' presentations, lead a discussion using their ideas and highlight the following facts.

- That when a relationship between several unknown terms is given in equation form, it is defined as a formula.
- That any unknown in a formula can be converted into the subject of the formula.
- That the order of the steps performed in constructing the relationship between the terms as a formula, should be identified.
- That when the subject of a formula is being changed, the inverse order of the steps that were performed in the construction of the formula should be performed.

(20 minutes)

**Criteria for Assessment and Evaluation:**

- Converts into the subject of the formula, the group of terms which includes the term to be made the subject of the formula.
- Changes the subject of the formula by performing the correct steps.
- Directly changes the given term to the subject of the formula.
- Sees the relationship between the given information.
- Engages in the relevant task by performing the correct steps.



## 17. Circumference of a Circle

**Competency 7** : Carries out daily tasks effectively by investigating the various methods of finding the perimeter.

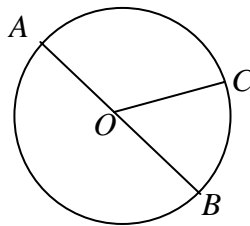
**Competency Level 7.1** : Develops the relationship between the diameter and the circumference of a circle.

**Time** : 60 minutes.

### Learning –Teaching Process:

#### Step 1 :

Present the following figure to the class and lead a discussion by inquiring from the students regarding the centre, radius, diameter and circumference of the circle.



During this discussion, highlight the following facts.

- That the distance from the centre of a circle to the circle is defined as the radius ( $r$ ) of the circle.
- That length of a chord of a circle which passes through the centre of the circle is defined as the diameter ( $d$ ) of the circle.
- That the diameter of a circle ( $d$ ) is twice the radius ( $r$ ). ( $d = 2r$ )
- That the length around the circle, which is the perimeter of the circle, is defined as the circumference of the circle ( $c$ ).

(10 minutes)

#### Step 2 :

Engage the students in a creative activity by using the following leaflet on exploration.

#### Leaflet on Exploration

- Focus your attention on the set of circular objects assigned to your group.

Case 1 – A two rupee coin, the lid of a powdered milk tin  
 Case 2 - A small saucepan, a tumbler with a uniform cross-section  
 Case 3 – A salmon tin, a jam bottle  
 Case 4 - A rim of a bicycle, a bangle

- Measure and write down the diameter of the circular objects you received. (Use a set square, piece of twine, a metre ruler)
- Groups that received cases 1 and 3 measure the circumference by using a piece of twine and groups that received cases 2 and 4 measure the circumference by rolling the object.
- Using a calculator, calculate the ratio  $\frac{c}{d}$  of the circumference ( $c$ ) and the diameter ( $d$ ).
- Complete the following table using the information you gathered.

Circular Object	Circumference ( $c$ )	Diameter ( $d$ )	$\frac{c}{d}$
1.			
2.			

- Examine whether the value which you obtained for  $\frac{c}{d}$  in the two instances is approximately equal to a constant value.
- Take another circular object and measure the circumference and the diameter. Observe whether you get the value of the circumference when you multiply the diameter by the above constant.
- Using the diameter ( $d$ ) and the above constant value, construct a formula to calculate the circumference ( $c$ ) of a circular object.
- Prepare to present the group's findings.

(30 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That for any circular object,  $\frac{c}{d}$  is approximately equal to 3.1.
- That the symbol  $\pi$  is used for this value.
- That for convenience,  $\pi = \frac{22}{7}$  is used in calculations. (But  $\pi$  is an irrational number).
- That accordingly, we can write  $c = \pi d$  or  $c = 2\pi r$ .
- That when the radius or the diameter is given, the circumference of the circle can be found by using the above formulae.
- That the radius or the diameter of a circle can be calculated when the circumference of the circle is known.

(20 minutes)

**Criteria for Assessment and Evaluation:**

- Identifies the relationship between the diameter and the circumference of a circle by measuring the diameter and the circumference of circular shaped objects, using various methods.
- Writes down as a formula, the relationship between the diameter and the circumference of a circular shaped object.
- Calculates the circumference of a circle using the formula, when the radius or the diameter is given.
- Tests various methods to solve problems.
- Engages in the relevant task by working as a team.

## 18. Pythagoras' Relationship

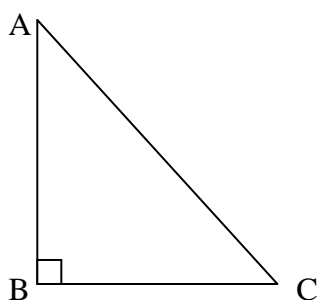
**Competency 23** : Makes decisions regarding day to day activities based on geometrical concepts related to rectilinear plane figures.

**Competency Level 23.4** : Applies Pythagoras' relationship to solve day to day problems.

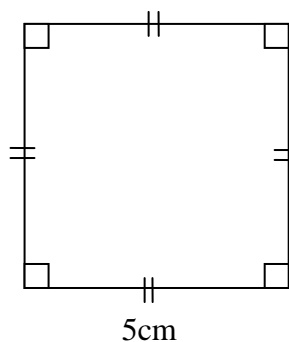
**Time** : 80 minutes.

**Learning –Teaching Process:**

**Step 1 :**



(i)



(ii)

Present figures of the form (i) above and inquire from the students regarding the hypotenuse and the sides which include the right angle of a right triangle, and present figures of the form (ii) and inquire about the method of finding the area of a square. Lead a discussion on the above and highlight the following facts.

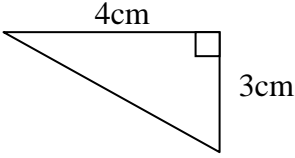
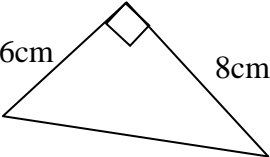
- That the side opposite the right angle of a right triangle is defined as the hypotenuse of the triangle and that the other two sides are defined as the sides which include the right angle.
- That the area of a square can be obtained by taking the square of the length of a side.

(10 minutes)

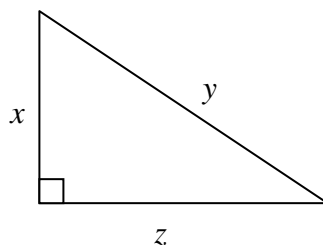
**Step 2 :**

Engage the students in the activity by using the following leaflet on exploration. Provide each group with a grid with  $1\text{cm} \times 1\text{cm}$  squares on a transparent sheet.

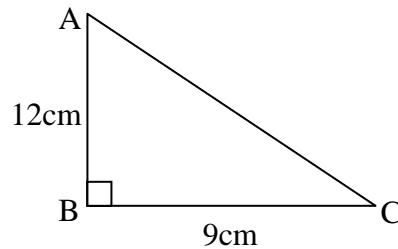
**Leaflet on Exploration**

Group	Figure
1, 3	
2, 4	

- Focus your attention on the right angled triangle received by your group.
- Draw this right angled triangle to the given scale on another piece of paper.
- Draw squares on the sides of the triangle by using a straight edge and a set square.
- Name the square drawn on the hypotenuse as P and the other two squares as Q and R. Using the grid on the transparent sheet, find the area of the squares P, Q and R.
- Discover the relationship between the areas of the triangles P, Q and R.
- Examine the accuracy of the relationship your group discovered, by cutting the squares Q and R into various shapes and placing them over the square P.
- By writing the area of each square in terms of the length of the relevant side of the triangle and using the relationship you discovered, develop a relationship between the sides of the right angled triangle your group received.
- Using the relationship you discovered, write an equation to represent the relationship between the lengths of the sides of the following right triangle.



- By using the text book or by some other method, propose a suitable name for the relationship your group discovered.
- By using the relationship between the sides of a right triangle, find the length of the side AC of the following right triangle.



- Give situations in day to day life when the above relationship is used.
- Prepare for a presentation at the plenary session.

(40 minutes)

### Step 3 :

After the students' presentations, lead a discussion and highlight the following facts.

- That the area of the square drawn on the hypotenuse of a right angled triangle is equal to the sum of the areas of the squares drawn on the two sides which include the right angle.
- That the above relationship is defined as Pythagoras' relationship.
- That according to Pythagoras' relationship, the square of the length of the hypotenuse of a right triangle is equal to the sum of the squares of the lengths of the remaining two sides.
- That Pythagoras' relationship can be used to find the length of one side of a right angled triangle when the lengths of the other two sides are given.

(30 minutes)

### Criteria for Assessment and Evaluation:

- Explains Pythagoras' relationship using examples.
- Verifies Pythagoras' relationship for right angled triangles by using various methods.
- Solves problems by using Pythagoras' relationship.
- Reaches conclusions by recognizing relationships.
- Uses various methods to reach conclusions.

## 19. Graphs

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

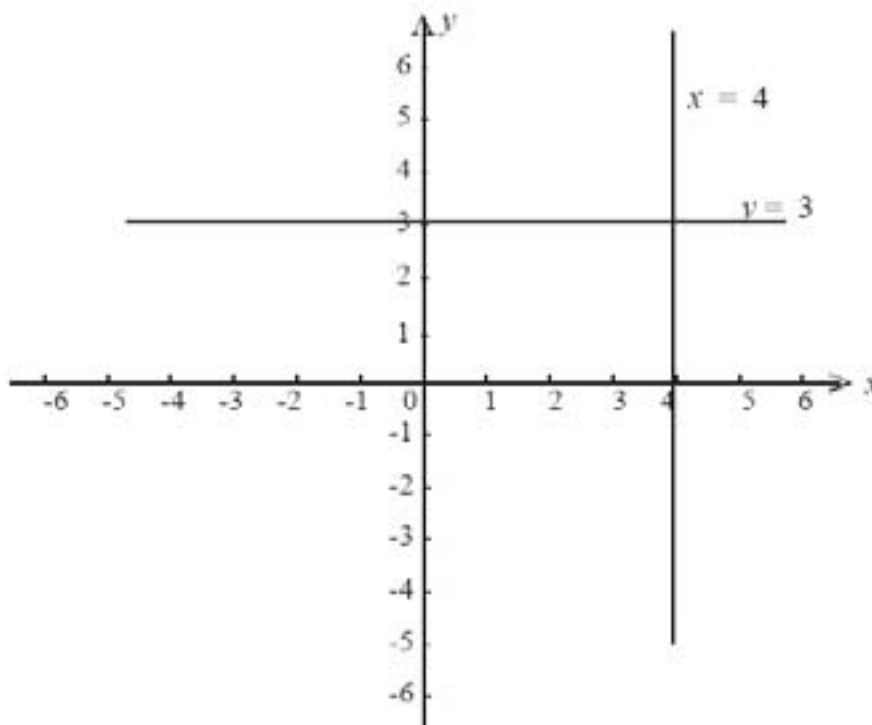
**Competency Level 20.1** : Analyzes pictorial representations of the mutual linear relationship between two variables.

**Time** : 90 minutes.

### Learning –Teaching Process:

#### Step 1 :

Lead a discussion on substituting integers into algebraic expressions of the form  $2x$ ,  $2x + 3$  and simplifying them, and also by presenting the following graph, about its properties.



During this discussion, highlight the following facts.

- That numerical values can be obtained for an algebraic expression by substituting different values for the unknown in the expression.
- That the straight line through a point with  $x$  coordinate  $a$  and parallel to the  $y$ -axis is given by the equation  $x = a$ .
- That the straight line through a point with  $y$  coordinate  $b$  and parallel to the  $x$ -axis is given by the equation  $y = b$ .

(10 minutes)

**Step 2 :**

Engage the students in a group activity by using the following leaflet on exploration.

**Leaflet on Exploration**

(1) $y = x$	(1) $y = -x$
(2) $y = 2x$	(2) $y = -2x$
(3) $y = 3x + 1$	(3) $y = -3x - 1$
(4) $3x - y = 6$	(4) $-x + 3y = -6$
(1) $y = x$	(1) $y = -x$
(2) $y = 2x + 1$	(2) $y = -3x + 2$
(3) $y = 2x - 2$	(3) $y = -3x - 2$
(4) $x + 2y = -6$	(4) $x - 3y = 6$

- Focus your attention on the set of equations received by your group.
- Substitute the values -2, -1, 0, 1, 2 for  $x$  in the equations (1), (2) and (3), find the corresponding  $y$  values for each equation and using these values plot the graphs of the equations on a coordinate plane.
- Substitute the values -6, 0, 6 for  $x$  in equation (4), find the corresponding  $y$  values and plot the graph of this equation on the same coordinate plane.
- Mark two points on each line, and for each case find the value of   
"difference between the two  $y$  coordinates"  
"difference between the two  $x$  coordinates" .
- Mark two other points on each line and see whether you obtain the same values that you obtained above for these points too.
- Examine whether there is a relationship between the values obtained above for equations (1), (2) and (3) and the coefficient of  $x$  in each equation.
- Discuss what type of angle each of the straight lines you plotted makes with the positive  $x$ -axis.
- Discuss the relationship between equation (3), and the  $y$  coordinate of the intersection point of the straight line corresponding to equation (3) and the  $y$ -axis. Write down your ideas.
- Discuss the difference between the way equation (4) has been represented in comparison with the other three equations.
- Discuss whether there is a difference between the graph of equation (4) and the other graphs.
- Prepare to present the group's findings.

(50 minutes)



**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That a relationship between  $x$  and  $y$  of the form  $y = mx + c$  is a function.
- That when the coefficient of  $x$  in an equation of the form  $y = mx + c$  is positive, the graph makes an acute angle with the positive  $x$ -axis, and that when the coefficient is negative, the graph makes an obtuse angle with the positive  $x$ -axis.
- That the gradient of the graph is obtained by the ratio of the difference between the  $y$  coordinate of two points on the graph and the difference between the  $x$  coordinate of the same two points.
- That the  $y$  coordinate of the intersection point of the graph and the  $y$ -axis is the intercept.
- That when an equation is given in the form  $y = mx + c$ ,  $m$  denotes the gradient and  $c$  the intercept of the graph.
- That the equation of a graph can also be given in the form  $ax + by = c$ .
- That straight line graphs which have the same gradient are parallel to each other.

(30 minutes)

**Criteria for Assessment and Evaluation:**

- For a given domain, graphs equations of the form  $y = mx$  accurately.
- For a given domain, graphs equations of the form  $y = mx + c$  accurately.
- Graphs any given function accurately and finds the gradient and the intercept.
- Uses suitable methods to communicate information.
- Represents the relationship between two sets of information pictorially.

## 20. Inequalities

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

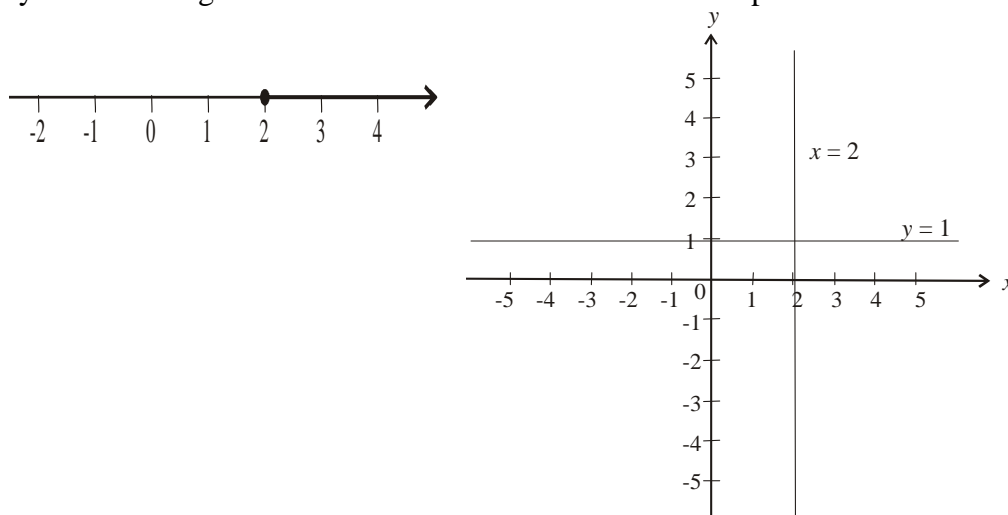
**Competency Level 20.2** : Represents the behaviour of a variable given by an inequality in a Cartesian Plane.

**Time** : 80 minutes.

### Learning –Teaching Process:

#### Step 1 :

Display the following chart with the number line and Cartesian plane in the classroom.



Lead a discussion by drawing attention to the representations on the number line and on the Cartesian plane. During this discussion, highlight the following facts.

- That the inequality  $x \geq 2$  is represented on the number line.
- That if  $a$  denotes a number on the number line then  $x = a$ ,  $x > a$ ,  $x < a$ ,  $x \geq a$  and  $x \leq a$  can be represented on the same number line.
- That a set of points with equal  $x$  coordinate all lie on a single straight line which is parallel to the  $y$ -axis.
- That the straight line through the points with  $x$  coordinate equal to  $a$  and parallel to the  $y$ -axis is the line  $x = a$ .
- That a set of points with equal  $y$  coordinate all lie on a single straight line which is parallel to the  $x$ -axis.
- That the straight line through the points with  $y$  coordinate equal to  $b$  and parallel to the  $x$ -axis is the line  $y = b$ .
- That the set of points with the  $x$  and  $y$  coordinates equal to each other lie on the straight line  $y = x$

(10 minutes)

**Step 2 :**

Engage the student groups in the activity by using the following leaflet on exploration. For this activity, provide each group with a graph paper.

**Leaflet on Exploration**

- On the graph paper, draw a Cartesian coordinate plane with the  $x$  and  $y$ -axes labeled from  $-5$  to  $+5$ .
- On the coordinate plane, plot the graph of the straight line given by the equation assigned to you from the following equations.
  - $x = 3$
  - $x = -3$
  - $y = 3$
  - $y = -3$
- Complete the following table by observing the location of the given points with respect to the graph of the straight line. Mark a  $\surd$  if the point lies in the given region. Otherwise mark a  $\times$ .

Point	Location		
	On the straight line	Above or on the right of the straight line	Below or on the left of the straight line
(3, 4)			
(-3, 5)			
(5, -3)			
(2, 3)			
(-4, -2)			
(0, -4)			

- Identify whether the location of the above points are on the left, on the right, above, below or on the graph of the straight line.
- Write down the identified regions in words using either  $x$  or  $y$ . Express the regions symbolically using  $<$ ,  $>$  or  $=$  with  $x$  or  $y$ .
- On the coordinate plane, separately shade each region you identified.
- Draw the line  $y = x$  on the coordinate plane, select a point in each of the regions  $y > x$ ,  $y = x$  and  $y < x$ , and write down the coordinates of the points.
- Examine the relationship between the  $x$  and  $y$  coordinates of each of the points you selected.
- Select any point you like and by considering its coordinates, write down which region it belongs to.
- Propose a method of indicating when representing the regions  $y \geq x$ ,  $y > x$  on the coordinate plane, the fact that  $y = x$  belongs or does not belong to the region.
- Shade the region  $y > x$  on the coordinate plane.
- Prepare to present your findings at the plenary session.

(40 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That a straight line drawn on a coordinate plane divides the plane into three regions.
- That if a straight line drawn on a coordinate plane represents  $x = a$  or  $y = a$ , then the three regions are denoted by  $x = a, x > a, x < a$  or by  $y = a, y > a, y < a$  respectively.
- That in the case  $x \leq a$  or  $x \geq a$ , apart from the inequality  $x < a$  or  $x > a$ , since  $x = a$  also belongs, a continuous straight line should be drawn through  $x = a$  to represent it.
- That in the case  $x > a$  or  $x < a$ , since  $x = a$  does not belong, the straight line  $x = a$  should be represented by a dotted line.
- That the regions are separated by  $y = a$  in the same manner as above.
- That regions  $y = x, y > x, y < x, y \geq x$  and  $y \leq x$  are created in the coordinate plane by the straight line  $y = x$ .
- That the region in which a point is located relative to a straight line can be identified by its coordinates.

(30 minutes)

**Criteria for Assessment and Evaluation:**

- For an integer  $a$ , writes down the coordinates of points in the region  $x > a, y > a, x < a$ , and  $y < a$  of a coordinate plane.
- For an integer  $a$ , represents the region  $x > a, y > a, x < a$  or  $y < a$  on a coordinate plane.
- Represents the region  $y > x, y < x, y \geq x$  or  $y \leq x$  on a coordinate plane.
- Develops relationships by representing information pictorially.
- Makes decisions in accordance with given conditions.

## 21. Sets

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

**Competency Level 30.1** : Identifies various systems and engages in performing set operations.

**Time** : 80 minutes.

### Learning –Teaching Process:

#### Step 1 :

Present the following chart to the class and lead a discussion and highlight the following facts.

$A = \{\text{Odd numbers greater than 0 and less than 10}\}$   
 $A = \{1, 3, 5, 7, 9\}$   
 $B = \{\text{Even numbers greater than 0 and less than 10}\}$   
 $B = \{2, 4, 6, 8\}$   
 $\varepsilon = \{0 \text{ or a natural number less than } 11\}$   
 $\varepsilon = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

- That dual braces are used to represent a set.
- That the set containing all the elements under consideration is the **universal set**.
- That the symbol  $\varepsilon$  is used to denote the universal set.

(10 minutes)

#### Step 2 :

Engage the students in the following activity and provide them with the opportunity to explore sets and their operations.

#### Leaflet on Exploration

1.  $A = \{\text{Multiples of } 2\}$   
 $B = \{\text{Multiples of } 2 \text{ greater than } 0 \text{ and less than } 7\}$
  2.  $A = \{\text{Multiples of } 3\}$   
 $B = \{\text{Multiples of } 3 \text{ greater than } 0 \text{ and less than } 10\}$
  3.  $A = \{\text{Multiples of } 4\}$   
 $B = \{\text{Multiples of } 4 \text{ greater than } 0 \text{ and less than } 15\}$
  4.  $A = \{\text{Multiples of } 5\}$   
 $B = \{\text{Multiples of } 5 \text{ greater than } 0 \text{ and less than } 20\}$
- $C = \{\text{Natural numbers less than } 20\}$

- Focus your attention on the pair of sets received by your group. Write down the elements of the sets A and B.
- Can all the elements of the sets A and B be written down?
- By using the text book or by some other method, propose suitable names for the sets such that all the elements can be written down and the sets such that all the elements cannot be written down.
- Do all the elements in set B belong to set A?
- Find the relationship between the sets A and B and propose a suitable name for it.
- Write down all the sets which contain one or more elements of the set B, as well as the empty set.
- Now considering only the sets B and C and taking C as the universal set, determine whether there are elements in C which do not belong to set B. Represent these sets in a Venn diagram.
- If there exist such elements, using the textbook, propose a suitable notation for the set which consists of only these elements.
- Write down the elements of the sets  $X = \{\text{Positive multiples of 2 less than 20}\}$  and  $Y = \{\text{Positive multiples of 3 less than 20}\}$ .
- If there are elements which are common to both the sets X and Y, write them down as a set. Propose a notation for this set.
- Write down as a single set, all the elements which belong to both the sets A and B. Propose a notation for this set.
- Prepare to present your findings to the others in the class.

(50 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That a set with a limited (finite) number of elements is defined as a **finite set**.
- That a set with an unlimited (infinite) number of elements is defined as an **infinite set**.
- That a set which consists of all the elements of a given set is a **subset** of the given set.
- That a set which consists of some of the elements of a given set is also a subset of the given set.
- That the empty set is a subset of any given set.
- That a set with  $n$  elements has  $2^n$  subsets.
- That the symbol  $\subset$  is used to indicate that a set is a subset of another set.
- That the set of elements which do not belong to a given set but belong to the universal set is defined as the **complement** of the given set.
- That the complement of the set A is denoted by  $A'$ .
- That the set which consists of only the elements which are common to two sets is the **intersection set** of the two sets.
- That the symbol  $\cap$  is used to denote the intersection of two sets.
- That the set which consists of all the elements of two given sets is the **union set** of the two sets.
- That the symbol  $\cup$  is used to denote the union of two sets.

(20 minutes)

**Criteria for Assessment and Evaluation:**

- Classifies given sets as finite or infinite sets.
- Separately writes down the intersection and the union of two given sets.
- Solves problems by using set operations.
- Makes decisions regarding set operations by using the symbols accurately.
- Aids in classifying the sets found in the environment.

## 22. Area I

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

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

**Time** : 120 minutes.

### Learning –Teaching Process:

#### Step 1 :

Lead a discussion so that the following facts on the area of a triangle and the circumference of a circle are highlighted

- That if the length of the base of a triangle is  $a$  and if the perpendicular distance from the opposite vertex to the base is  $b$ , then the area of the triangle is given by  $\frac{1}{2}ab$ .
- That the length around a circle is defined as the **circumference** of the circle.
- That if the radius of a circle is  $r$ , then the circumference of the circle is given by  $2\pi r$ .
- That  $\pi = \frac{22}{7}$  or 3.14 is used in calculations.

(10 minutes)

#### Step 2 :

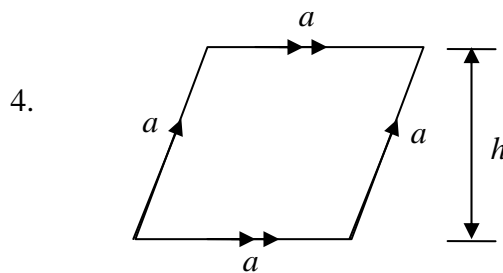
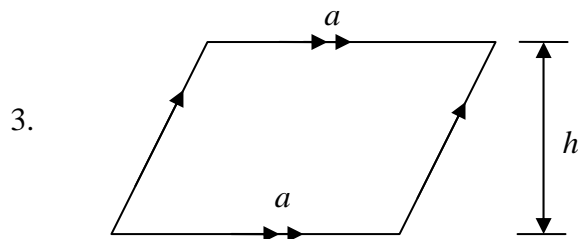
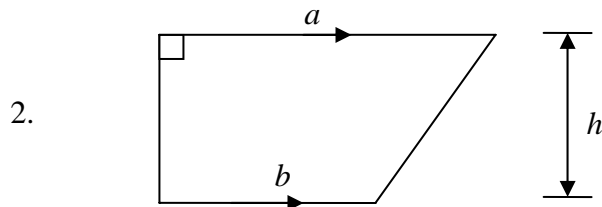
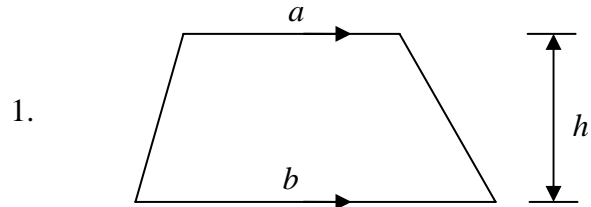
Engage the students in the following two activities and provide them with the opportunity to explore the area of a parallelogram, the area of a trapezium and the area of a circle.



**Leaflet on Exploration**

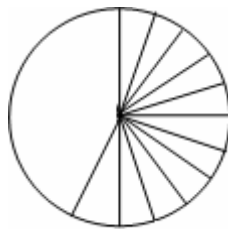
Let us develop expressions for the area of plane figures

**Part I**



	<i>a</i>	<i>b</i>	<i>h</i>
1	8cm	12cm	5cm
2	10cm	6cm	5cm
3	10cm	--	5cm
4	6cm	--	5cm

- Copy the figure received by your group on a piece of paper and note down its name and its properties.
- Divide the figure into two triangles and find the area of each triangle. Develop an expression for the area of the figure in terms of  $a$ ,  $b$  and  $h$ .
- Obtain a value for the area of the figure by substituting the given values of  $a$ ,  $b$  and  $h$  into the expression you obtained.
- Express in your own words how the area of any figure which is similar in shape to the figure you obtained can found.



Case 1 → radius 5 cm

Case 2 → radius 6 cm

Case 3 → radius 7 cm

Case 4 → radius 8 cm

- On a coloured paper, draw a circle with the radius assigned to your group. By joining the centre to points on the circle, divide the circle into several small sectors as shown in the above figure.
- On another piece of paper, organize the sectors such that they form roughly the shape of a rectangle and paste them on the sheet of paper.
- By using the fact that the circumference of a circle is given by  $2\pi r$ , determine the length and the breadth of the rectangle. Thereby develop an expression for the area of the circle.
- Find the area of the circle by substituting the given value of  $r$  in the expression you developed.
- Present your ideas and proposals on how the circle should be divided so as to form the most accurate rectangular shape.
- Prepare to present your group's findings at the plenary session.

(80 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That the area of a parallelogram is given by the product of the base length and the perpendicular distance from the opposite side to the base.
- That thus, if the base length of a parallelogram is  $a$  and the perpendicular distance from the opposite side to the base is  $h$ , the area of the parallelogram is given by  $ah$ .
- That if the length of a side of a rhombus is  $a$  and the perpendicular distance between two parallel sides is  $h$ , then the area of the rhombus is given by  $ah$ .
- That the area of a trapezium is one half of the product of the perpendicular distance between the two parallel sides and the sum of the lengths of the two parallel sides.
- That thus, if the length of the two parallel sides of a trapezium is  $a$  and  $b$  respectively, and the perpendicular distance between the two parallel sides is  $h$ , then the area of the trapezium is given by  $\frac{h}{2}(a + b)$ .
- That if the radius of a circle is  $r$ , then the area of the circle is given by  $\pi r^2$ .
- That by dividing the circle into very small sectors a more accurate rectangle can be formed.

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Describes how the area of a trapezium, a parallelogram and a rhombus can be found in terms of its measurements.
- Using the given measurements, calculates the area of a trapezium, a parallelogram and a rhombus.
- Using the given measurements, calculates the area of any given plane figure such as a trapezium, a parallelogram, a rhombus, a circle.
- Discovers relationships by investigating information.
- Makes decisions for future needs based on relationships.

## 22. Area II

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

**Competency Level 8.2** : Investigates the shapes of the surfaces of solids in the environment and determines their area.

**Time** : 90 minutes.

### Learning –Teaching Process:

#### Step 1 :

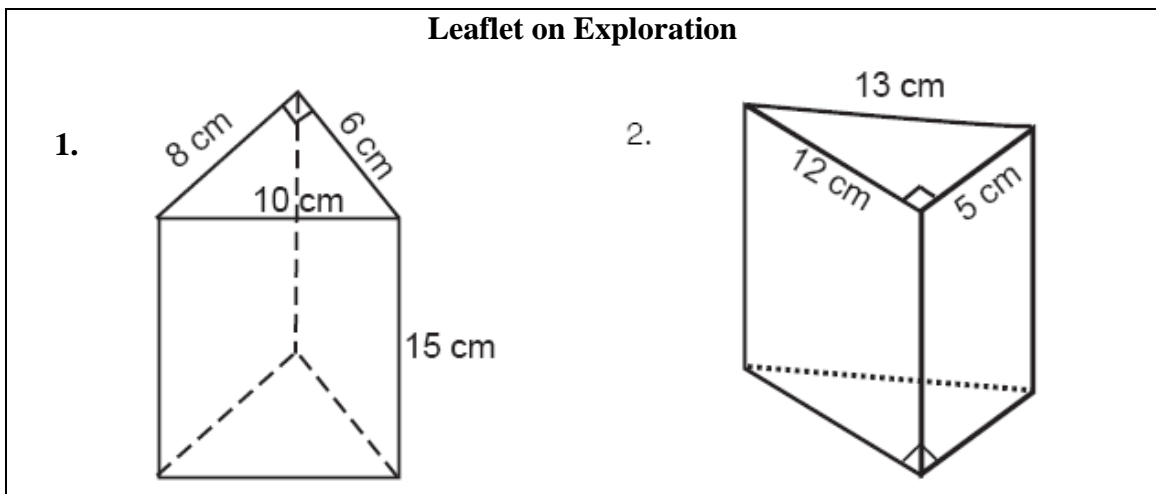
Display a rectangle, a right triangle and another triangle in the classroom. Lead a discussion on their area and also on the faces of a prism by presenting one, and highlight the following facts.

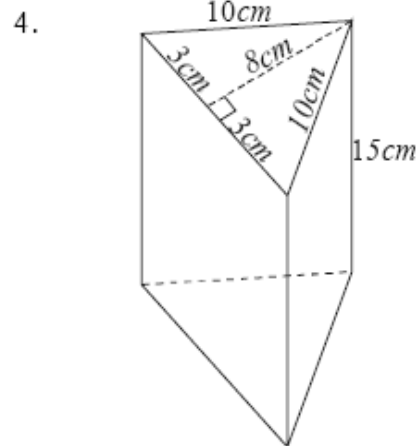
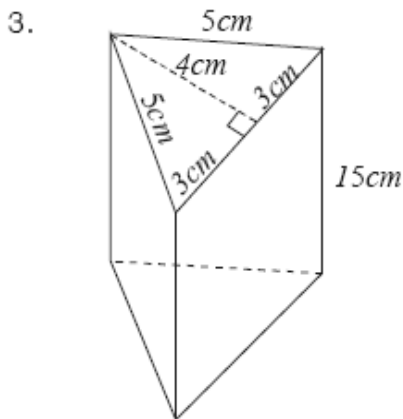
- That the area of a rectangle is obtained by multiplying its length by its breadth.
- That the area of a right triangle is equal to one half of the product of the lengths of the two sides which include the right angle.
- That the area of a triangle is equal to one half of the product of the base length and the perpendicular distance from the opposite vertex to the base.
- That solids with a uniform cross section are defined as prisms.

(20 minutes)

#### Step 2 :

Engage the students in the following activity and provide them with the opportunity to explore the surface area of right triangular prisms.





- The figure you have received is a right triangular prism. Draw this on a piece of paper. Mark the given measurements on it.
- Determine the shape of the faces, draw each of them separately and include their measurements.
- Describe the shape of each face.
- Determine whether there are faces which are equal in shape and size.
- Calculate the area of each of the faces and thereby determine the surface area of the prism.
- Prepare to present your group's findings at the plenary session.

(40 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That a right triangular prism has five faces.
- That a right triangular prism has a uniform cross-section.
- That a right triangular prism has two triangular faces of equal shape and size.
- That a right triangular prism has three rectangular faces.
- That the total surface area of a right triangular prism is obtained by adding the areas of all its faces.

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Accurately expresses the shape and measurements of the faces of a right triangular prism.
- Describes the method of finding the total surface area of a right triangular prism.
- Accurately calculates the total surface area of a right triangular prism.
- Easily analyses pictorial representations of three dimensional objects.
- Works with an awareness of the environment.

## 23. Probability

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

**Competency Level 31.1** : Investigates the likelihood of an event occurring based on the occurrences.

**Time** : 60 minutes.

### Learning –Teaching Process:

#### Step 1 :

Lead a discussion on events that definitely occur, events that definitely do not occur, events that sometimes occur, experimental probability, theoretical probability and the number of elements in a set. During this discussion, highlight the following facts.

- That the fraction of success can be found by considering the number of successful outcomes obtained in experiments.
- That the fraction of success can be obtained by dividing the number of successful outcomes by the total number of times that the experiment is conducted.
- That the probability found by considering equally likely events instead of conducting experiments is defined as the theoretical probability.
- That the number of elements in the set A is written as  $n(A)$ .

(10 minutes)

#### Step 2 :

Engage the students in a practical experiment by using the following leaflet on exploration.

#### Leaflet on Exploration

##### Experiment

1. Tossing once, a cubic die with the numbers 1, 2, 3, 4, 5, 6 marked on its faces.
  2. Tossing a coin up once.
  3. Removing a bead without selection from a bag which contains a red, a blue, a yellow and a green bead, all of which are of the same size and shape.
  4. Removing one card without selection from a set of 5 equal sized cards with the numbers 1, 2, 3, 4, 5 marked on them.
- Focus your attention on the experiment received by your group from the above experiments.
  - Discuss whether the outcome of an experiment can be stated precisely before it is carried out.
  - Write down the set of all possible outcomes of the experiment your group received.

- Propose a suitable name for this set by using the textbook or by some other method.
- If there is an equal likelihood of each outcome of the experiment occurring, can you determine what the probability of each outcome is?
- Carryout the experiment assigned to you 50 times over and note down the experimental probability of each outcome in the following table.

Outcome	Experimental Probability

- Compare the experimental probability and the theoretical probability of each outcome of the experiment received by your group.
- Accordingly, what can you conclude regarding the likelihood of the outcomes occurring?
- By using your textbook propose a suitable name for such outcomes.
- Prepare to present your group's findings to the others in the class.

(30 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That even if all the possible outcomes of a certain experiment are known beforehand, if the outcome of the experiment cannot be stated definitely beforehand, then the experiment is a random experiment.
- That the set which consists of all the possible outcomes of an experiment is the **sample space** of the experiment.
- That the sample space is denoted by the symbol  $S$ .
- That if in an experiment all the outcomes have an equal likelihood of occurring, the experiment is unbiased.
- That if the set of expected outcomes is denoted by  $A$ , and the sample space is denoted by  $S$ , then the probability of  $A$  occurring is  $P(A) = \frac{n(A)}{n(S)}$

(20 minutes)

**Criteria for Assessment and Evaluation:**

- Identifies and describes random occurrences.
- Expresses the equally likely events (outcomes).
- Calculates the probability of equally likely events by using the formula  $P(A) = \frac{n(A)}{n(S)}$ .
- Makes right decisions for the future based on predictions.
- Pays attention to the ideas of others.

## 24. Angles of a Polygon

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

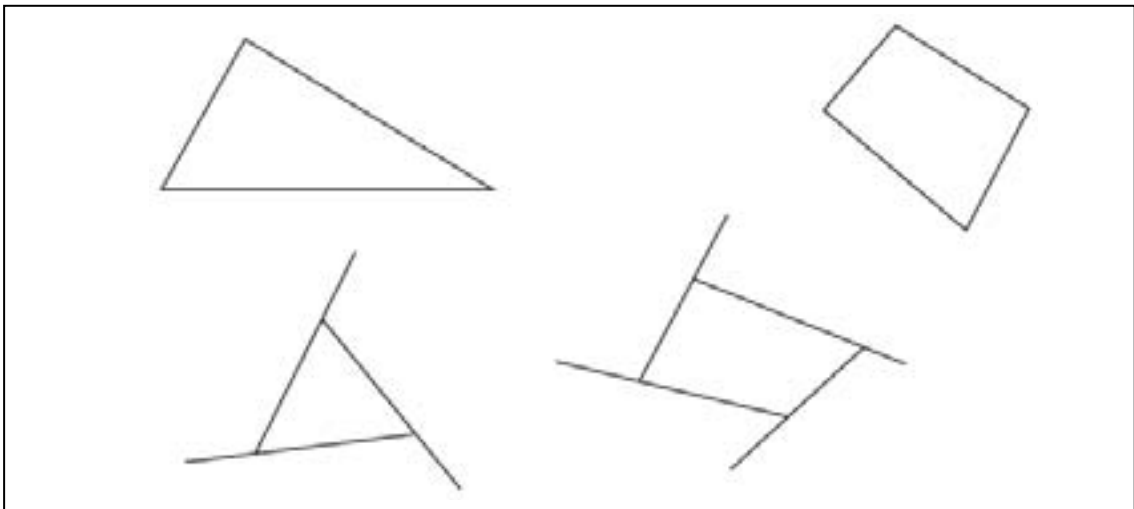
**Competency Level 23.3** : Performs calculations using the sum of the exterior and interior angles of polygons.

**Time** : 80 minutes.

### Learning –Teaching Process:

#### Step 1 :

Present the following set of figures to the class and lead a discussion on the shape of each plane figure and the angles in the figures.



During this discussion, highlight the following facts.

- That a closed plane figure bounded by straight line segments is defined as a **polygon**.
- That a closed plane figure bounded by three sides is defined as a triangle and that the triangle is the polygon with the least number of sides.
- That a closed plane figure bounded by four sides is defined as a **quadrilateral**.
- That the sum of the interior angles of a triangle equals  $180^\circ$ .
- That the sum of the interior angles of a quadrilateral equals  $360^\circ$ .
- That the exterior angles of a polygon are obtained by producing its sides.
- That the number of interior angles as well as the number of exterior angles of a polygon equals the number of sides of the polygon.

(20 minutes)

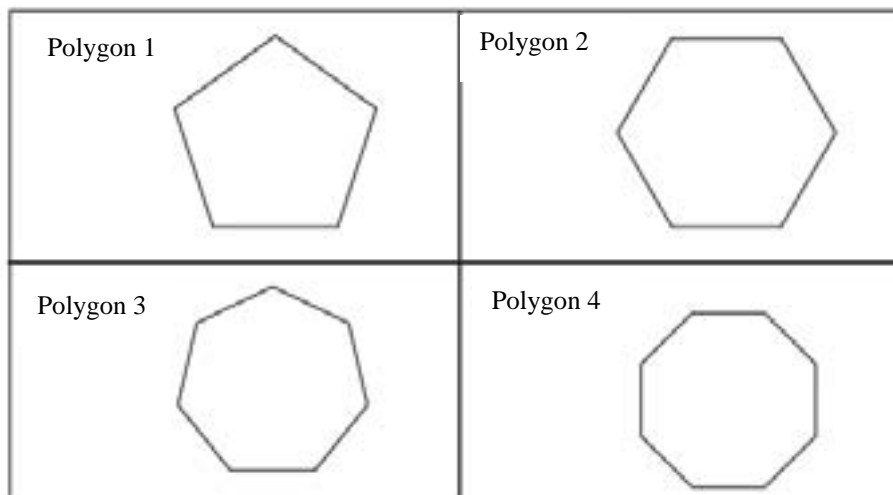
#### Step 2 :

Engage the students in an analytical study by using the following leaflet on exploration.



### Leaflet on Exploration

- Focus your attention on the polygon received by your group from the following polygons.



- Determine the number of sides the polygon you received has and propose a name for it.
- Divide the polygon into triangles using a common vertex and calculate the sum of the interior angles of the polygon by using the result on the sum of the interior angles of a triangle.
- Draw another polygon with as many sides as you like and in the same manner as above, calculate the sum of the interior angles.
- By considering a triangle, a quadrilateral and the polygon you received, determine whether there is a relationship between the number of sides of a polygon and the sum of its interior angles.
- Accordingly, write down an expression in terms of  $n$ , for the sum of the interior angles of an  $n$ -sided polygon.
- On another piece of paper make an enlarged copy of the polygon you received and draw all its exterior angles.
- Cut out all the exterior angles and paste them in a manner such that they do not overlap but such that their vertices coincide.
- What can you say about the sum of the exterior angles?
- Draw another polygon with as many sides as you like and determine whether the result you obtained above can be confirmed.
- What can you say about the sum of an interior angle of a polygon and the related exterior angle?
- If the sides of the polygon you received were of equal length and if all the interior angles too were of equal magnitude, propose a suitable name for the polygon.
- Prepare to present your group's findings at the plenary session.

(30 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That depending on the number of sides it has, a polygon can be classified as a quadrilateral, a pentagon, a hexagon etc.
- That if any polygon is divided into triangles, all having a common vertex which is also a vertex of the polygon, then the number of triangles obtained is 2 less than the number of sides of the polygon.
- That the sum of the interior angles of any polygon can be found by considering the number of triangles the polygon can be divided into, and using the result on the sum of the interior angles of a triangle.
- That the sum of the interior angles of an  $n$ -sided polygon is given by  $180^\circ(n - 2)$ .
- That the sum of the exterior angles of any polygon is  $360^\circ$ .
- That the sum of the exterior angles of a polygon is independent of the number of sides of the polygon.
- That for a polygon, the magnitude of an interior angle + the magnitude of the corresponding exterior angle =  $180^\circ$ .
- That a polygon with sides of equal length and interior angles of equal magnitude is defined as a **regular polygon**.
- That when the magnitude of an exterior angle of a regular polygon is known, the number of sides of the polygon can be found by using the relationship

$$\text{Number of sides} = \frac{360^\circ}{\text{Magnitude of an exterior angle}}$$

- That when the number of sides of a regular polygon is known, the magnitude of an exterior angle can be found by using the relationship

$$\text{Magnitude of an exterior angle} = \frac{360^\circ}{\text{Number of sides}}$$

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Calculates the sum of the interior angles, the sum of the exterior angles of a polygon when the number of sides of the polygon is given.
- When the magnitude of some of the interior or exterior angles of a polygon is given, calculates the magnitude of the other angles.
- For a regular polygon, determines the magnitude of an angle when the number of sides is known, and the number of sides when the magnitude of an angle is known.
- Applies generalized results to special situations.
- Works in cooperation within the group.

## 25. Algebraic Fractions

**Competency 16** : Solves problems encountered in day to day life by exploring the various methods of simplifying algebraic fractions.

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

**Time** : 70 minutes.

### Learning –Teaching Process:

#### Step 1 :

Lead a discussion by presenting several problems of the following type to the class and inquiring from the students regarding how they can be simplified.

$$(i) \frac{3}{5} + \frac{1}{5}$$

$$(ii) \frac{3}{4} + \frac{1}{4}$$

$$(iii) \frac{5}{7} - \frac{2}{7}$$

$$(iv) \frac{5}{6} - \frac{1}{6}$$

$$(v) 3x + 2x$$

$$(vi) 4m - 2m$$

During this discussion, highlight the following facts.

- That when adding fractions with equal denominators, only the numerators are added together.
- That when subtracting fractions with equal denominators, only the numerators are subtracted.
- That the answer should be given in the simplest form.
- That when algebraic expressions are being simplified, like terms can be added or subtracted.

(10 minutes)

#### Step 2 :

Engage the students in an activity by using the following leaflet on exploration.

Leaflet on Exploration			
<b>Part I</b>			
	<b>I</b>	<b>II</b>	<b>III</b>
<b>A</b>	$\frac{2}{3}$	$\frac{1}{5}$	$\frac{3}{4}$
<b>B</b>	$\frac{4}{x}$	$\frac{y}{3}$	$\frac{m}{n}$

- Focus your attention on the part assigned to your group.

- Describe the properties of the fraction given as A.
- Describe the properties of the fraction given as B.
- Discuss the difference between A and B.
- Based on it, by using the textbook or by some other method, propose a name for B.
- Mihiri, as a birthday treat, shared a quantity of  $y$  milk toffees equally between 5 of her friends. Represent the number of milk toffees that each friend got as a fraction.

**Part II**

I	II	III
$\frac{x}{5}$ $\frac{m}{2}$ $\frac{3}{5}$	$\frac{8}{m}$ $\frac{3}{p}$	$\frac{x}{y}$ $\frac{p}{3t}$ $\frac{x}{3t}$
$\frac{n}{2}$ $\frac{x+2}{5}$	$\frac{5}{m}$ $\frac{5}{x+1}$	$\frac{m+1}{x+1}$ $\frac{2m}{y}$
$\frac{n+1}{2}$ $\frac{y}{5}$	$\frac{3}{x+1}$ $\frac{1}{m}$ $\frac{2}{p}$	$\frac{y}{x+1}$ $\frac{m}{x+1}$

- Focus your attention on the part received by your group.
- Select several pairs of fractions with equal denominators.
- Add each pair of fractions separately and obtain the solution.
- Take one pair of fractions, subtract the second fraction from the first and obtain the solution.
- Now take the same pair of fractions and subtract the first fraction from the second and obtain the solution.
- Are the two solutions equal?
- Have a discussion regarding this.
- Follow the same procedure with the other pairs of fractions you selected.
- Write down more pairs of fractions of the above type,
  - add them and obtain the solution.
  - subtract one from the other and obtain the solution.
- Prepare to present your findings to the others in the class.

(30 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That a fraction containing algebraic terms in either the numerator or the denominator or both the numerator and the denominator is defined as an **algebraic fraction**.
- That two algebraic fractions with the same denominator can be added together.
- That if two algebraic fractions have the same denominator, then one fraction can be subtracted from the other.
- That when adding or subtracting algebraic fractions, the like terms in the solution can be simplified.
- That the solution you obtain when you subtract one fraction from another is in general not equal to the solution you obtain when you reverse the order of the fractions.

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Simplifies fractions with equal denominators and with algebraic terms in the numerator.
- Simplifies fractions with equal algebraic terms in the denominator.
- Simplifies fractions with equal denominators and with algebraic terms in both the numerator and the denominator.
- Looks into situations in daily life in which problems occur.
- Makes right decisions by first carrying out discussions with the other groups.

## 26. Volume

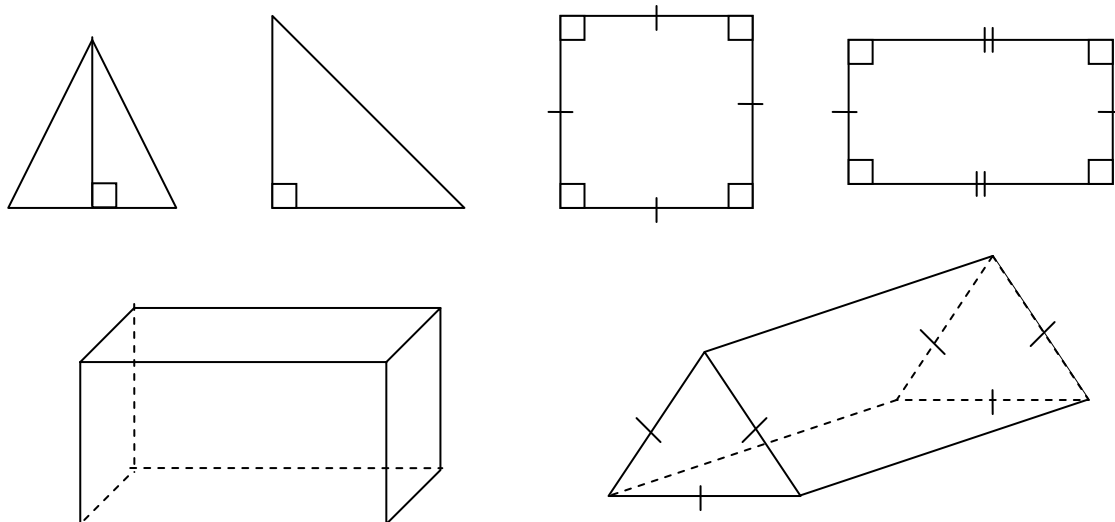
**Competency 10** : Gets the maximum out of space by working critically with respect to volume.

**Competency Level 10.1** : Determines the volume of prisms with different cross-sections.

**Time** : 80 minutes.

**Learning –Teaching Process:**

**Step 1 :**



Lead a discussion by presenting plane figures and solids of the above types to the class and by inquiring from the students regarding the area of the plane figures, the volume of the cuboid and the features of the prism. During this discussion, highlight the following facts.

- That the **volume** of a solid is the amount of space it occupies.
- That the volume of a cuboid is obtained by multiplying the area of its base by its height.
- That if the shape and size of the cross-section obtained by the intersection of a plane with a solid, when the plane is parallel to one of its faces, is the same shape and size as the face which the plane is parallel to, then the solid is said to have a uniform cross-section.
- That when a plane intersects a cube or a cuboid such that it is parallel to any one of the faces, the cross-section obtained by the intersection is identical in shape and size to the face that the plane is parallel to. But that for a right triangular prism, a uniform cross-section is obtained only when the plane which intersects the solid is parallel to the triangular faces.

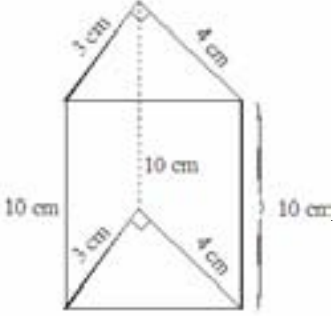
(20 minutes)

**Step 2 :**

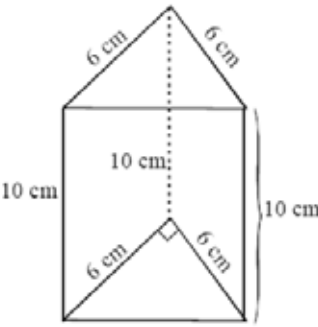
Engage the students in an explorative study by using the following leaflet on exploration.

**Leaflet on Exploration**

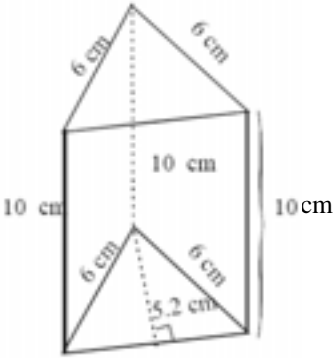
- Focus your attention on the figure of the solid assigned to your group and discuss about its shape.



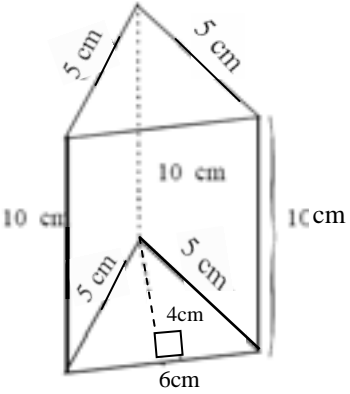
Group 1



Group 2



Group 3



Group 4

- Does the prism you received have a uniform cross-section?
- Find the area of a triangular cross-section of the prism.
- Find the volume of the prism by multiplying the area of the triangular cross-section by the height of the prism.
- If the area of the triangular cross-section of a right triangular prism is  $a$  square units and the height is  $h$  units, construct a formula for the volume ( $V$ ) of the prism.
- Give reasons for considering a cube and a cuboid as prisms.
- Prepare to present your findings at the plenary session.

(30 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That the cross-section of a triangular prism could be any triangle.
- That the area of the triangular cross-section is given by
$$\frac{1}{2} \times \text{length of base of triangle} \times \text{perpendicular height} .$$
- That the area of the triangular cross-section of a prism which has a right triangle as its base is one half of the product of the lengths of the two sides which include the right angle.
- That the volume of a prism is obtained by multiplying the area of the relevant cross-section by the height.
- That if the area of the triangular cross-section of a right triangular prism is  $a$  square units and the height is  $h$  units, then the volume of the prism is given by  $V = a \times h$  .
- That since a cube and a cuboid both have uniform cross-sections, they too are prisms.

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Constructs a formula for the volume of a prism in terms of the area of the cross-section and the height when the cross-section is an equilateral triangle, an isosceles triangle or a right triangle.
- Calculates the volume of a prism using the formula, when the cross-section is an equilateral triangle, an isosceles triangle or a right triangle.
- Calculates the volume of a prism when the cross-section is an equilateral triangle, an isosceles triangle or a right triangle as well as when the cross-section is a square or a rectangle.
- Discovers facts through analysis.
- Respects others' opinions within the group.



## 27. Scale Drawings I

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

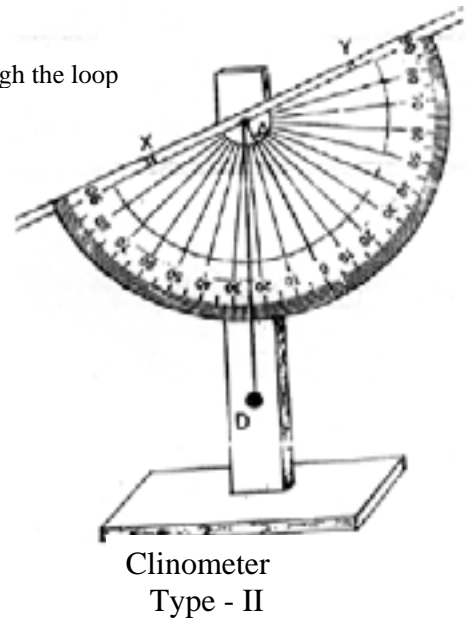
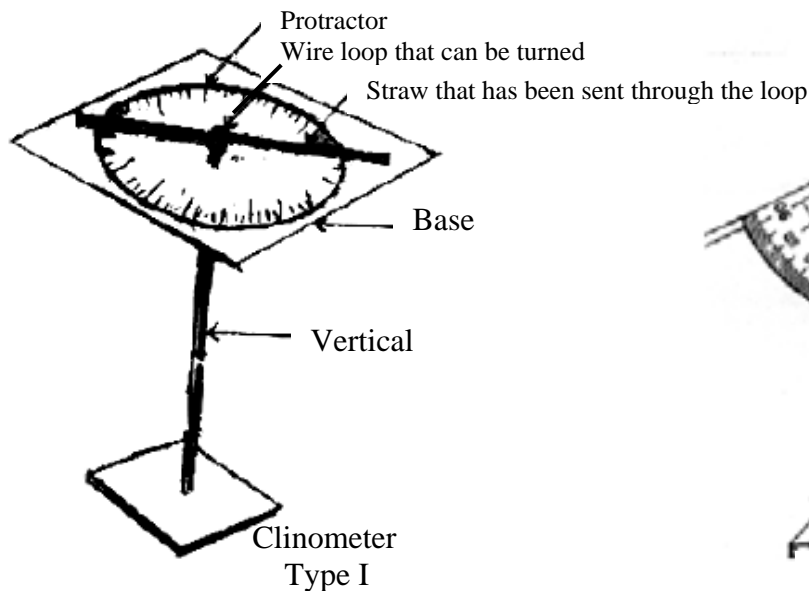
**Competency Level 13.1** : Uses angles of elevation and depression to indicate the location of an object.

**Time** : 80 minutes.

### Learning –Teaching Process:

#### Step 1 :

Present the following instruments to the class.



Lead a discussion and highlight the following facts with the aid of the instruments.

- That the position with respect to the north in a horizontal plane may be determined using a clinometer of type I.
- That the location in a vertical plane may be determined using a clinometer of type II.
- That when considering a location in a vertical plane, the horizontal level (eye level) is kept fixed.

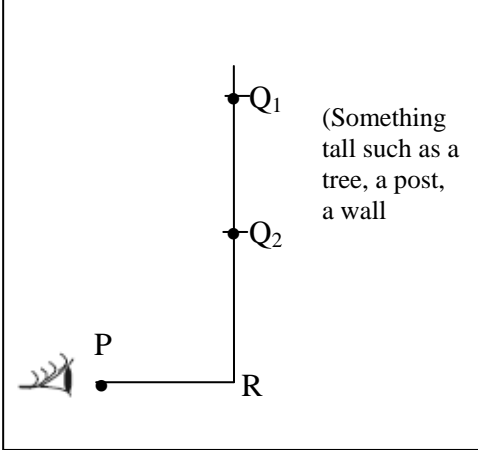
(20 minutes)

**Step 2 :**

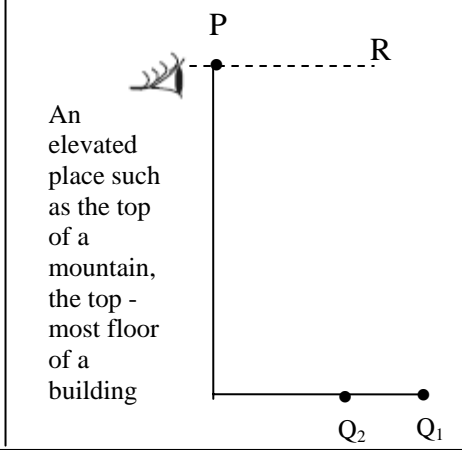
Engage the students in a creative activity by using the following leaflet on exploration. Before handing over the leaflet on exploration, select suitable locations for the students.

**Leaflet on Exploration**

- From the following, go to the location that has been assigned to you and observe it.

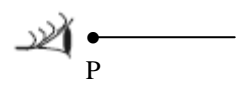
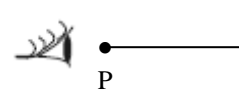


(i)



(ii)

- As indicated in the figure, select two points which can be observed from the point P and name them as Q<sub>1</sub> and Q<sub>2</sub>.
- Place the clinometer at P and turn it towards the direction of PR.
- With the aid of the clinometer located at P and turned in the direction of PR, observe the location of the points Q<sub>1</sub> and Q<sub>2</sub>.
- Using the clinometer, measure the angle that the locations Q<sub>1</sub> and Q<sub>2</sub> make with the horizontal PR from the observation point P.
- Fill in the following table using the information that you collected.

Point of Observation	Name of the location Q that was selected	The magnitude of the angle that the location Q makes with the horizontal PR from the observation point P	A pictorial representation of the rotation of the clinometer to this position
P	Q <sub>1</sub>		
	Q <sub>2</sub>		

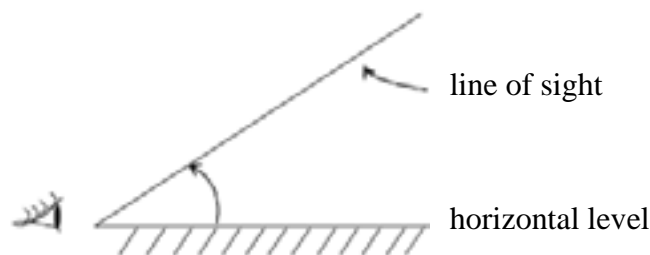
- Prepare to present your findings to the others in the class.

(30 minutes)

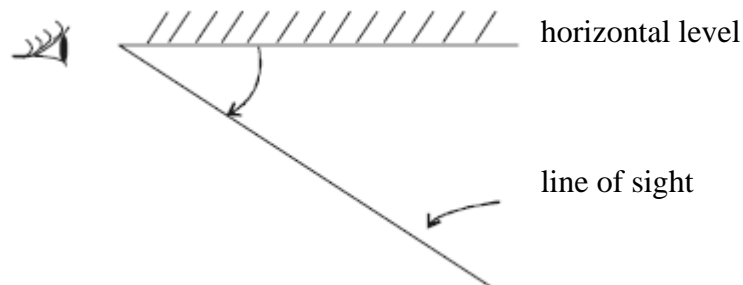
**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That the earth is considered as being horizontal and that a plane perpendicular to it is defined as a vertical plane.
- That the straight line from the point of observation to the point that is being observed is called the line of sight.
- That the angle which the line of sight makes with the eye level (horizontal) when observing an object which lies above the eye level is called an **angle of elevation**.



- That the angle which the line of sight makes with the eye level (horizontal) when observing an object which lies below the eye level is called an **angle of depression**.



(30 minutes)

**Criteria for Assessment and Evaluation:**

- Uses the clinometer accurately and accurately indicates the value of the angle.
- Pictorially represents whether the obtained angle is an angle of elevation or an angle of depression.
- Uses the angle of elevation and the angle of depression to indicate the position of an object.
- Uses various methods to obtain information.
- Is inclined towards developing instruments further to get better results.

## 27. Scale Drawings II

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

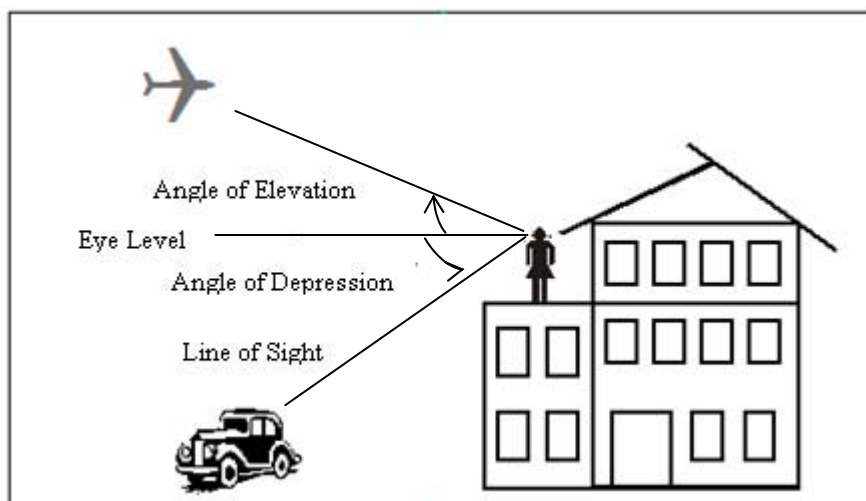
**Competency Level 13.2** : Manipulates scale drawings to represent various locations in the environment.

**Time** : 60 minutes.

### Learning –Teaching Process:

#### Step 1 :

Present a figure of the following form to the class and lead a discussion on the vertical plane, the location of an object, representation in scale drawings, angles of elevation, angles of depression and the facts that should be considered when making scale drawings.



During this discussion, highlight the following facts.

- That the earth is considered as being horizontal and that any plane which is perpendicular to the earth is defined as a vertical plane.
- That the angle of elevation is the angle which is formed between the eye level (horizontal level) and the line of sight when an object which is above the eye level is being observed.
- That the angle of depression is the angle which is formed between the eye level (horizontal level) and the line of sight when an object which is below the eye level is being observed.
- That a suitable scale should be selected when making a scale drawing.
- That a scale is written in the form  $1\text{ cm} \rightarrow y\text{ m}$  or  $b\text{ m} \rightarrow 1\text{ cm}$  or  $1 : x$ .
- That scale drawings are used to represent a large figure as a smaller figure as well as to represent a small figure as a larger figure.

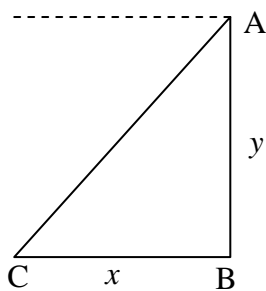
(10 minutes)

**Step 2 :**

Engage the students in the activity by using the following leaflet on exploration.

**Leaflet on Exploration**

Group	Information relevant to the scale drawing	Scale
1	A man on the top of a 20m high coconut tree observes a parked vehicle by looking down with an angle of depression of $50^\circ$ .	2m $\rightarrow$ 1cm
2	A child observing a window on the vertical wall of a building sees the window with an angle of elevation of $60^\circ$ . The distance from the foot of the building to the child is 45m.	5m $\rightarrow$ 1cm
3	A child who is playing in a field observes a man with an angle of elevation of $30^\circ$ when the man who is descending to earth with a parachute is 120m above the earth.	12m $\rightarrow$ 1cm
4	A child who is 60m away from the foot of a telephone post observes a bird on top of the post with an angle of elevation of $60^\circ$ .	6m $\rightarrow$ 1cm



- Taking AB to be the vertical height and CB to be the horizontal distance, represent your group's data by a sketch by using the given figure.
- With the aid of the sketch, make a scale drawing according to the given scale.

- Discuss how the actual length of  $x$  or  $y$  can be obtained by using the scale drawing, and find this length.
- Prepare to present your findings to the others in the class.

(40 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That the angle of elevation or the angle of depression should be used to draw figures related to a vertical plane.
- That when making a sketch, a height in a vertical plane can be represented by a straight line, while an object can be represented by a point.
- That a scale drawing can be made according to the data in a sketch by using a suitable scale.
- That to find the actual length, the length in the scale drawing should be measured using a ruler, and the value that is obtained should be multiplied by the scale.

(10 minutes)

**Criteria for Assessment and Evaluation:**

- Accurately indicates the angle of elevation, the angle of depression.
- Makes scale drawings according to the given scale.
- Represents various positions in the environment using scale drawings and calculates measurements.
- Develops the skill of representing various locations in the environment.
- Makes scale drawings by exploring various methods.

## 28. Data Representation and Data Interpretation I

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

**Competency Level 28.1** : Presents data in tabular form to facilitate communication.

**Time** : 160 minutes.

### Learning –Teaching Process:

#### Step 1 :

Number of king coconuts in a bunch ( $x$ )	Number of bunches ( $f$ )	$x \times f$
2	1	2
3	1	3
4	2	8
5	1	5
6	2	12
7	1	7
8	2	16
10	1	10
11	2	22
12	4	48
13	1	13
14	2	28
15	1	15
16	1	16
17	2	34
18	1	18
19	2	38
20	2	40
22	1	22
23	1	23
24	1	24
25	1	25
	33	429

Display the above frequency table in front of the class. Lead a discussion and highlight the following facts.

- That this table gives the varying number of fruits in 33 bunches of king coconuts.
- That the smallest bunch contains 2 king coconuts.
- That the largest bunch contains 25 king coconuts.
- That the number of fruits in the most number of bunches is 12.
- That there are three methods of finding a bunch which could represent all 33 bunches of king coconuts.
- That these representative values are called the mode, the median and the mean.

- That a frequency table was constructed to avoid the difficulty of writing the data one below the other and adding them up to find the mean.
- That however, due to the type of data in the above frequency distribution, constructing the frequency table has not helped in reducing the number of rows.
- That therefore a method has to be found to reduce the number of rows in a frequency table representing the data of a frequency distribution of the above type.

(20 minutes)

**Step 2 :**

Engage the students in the activity by using Part I of the following leaflet on exploration.

**Leaflet on Exploration**

**Part I**

- A suitable conversion to reduce the number of rows of the frequency table is given below. Study it

Number of fruits in a bunch of king coconuts $x$	Number of bunches of king coconuts $f$	$x \times f$		Number of fruits in a bunch of king coconuts	The median of the number of fruits in a bunch $x$	Number of bunches $f$	$x \times f$
2	1		(from 2 to 4)	2 - 4	3	4	12
3	1						
4	2						
5	1						
6	2						
7	1						
8	2						
9	0						
10	1						
11	2						
12	4						
13	1						
14	2						
15	1						
16	1						
17	2						
18	1						
19	2						
20	2						
21	0						
22	1						
23	1						
24	1						
25	1						



- Prepare a frequency table by grouping the above data into 6 classes.
- If 2 – 4 is considered as one class, and the other classes are formed similarly, how many classes will there be in total in the frequency table?
- Prepare a frequency table with 7 to 10 classes for the frequency distribution received by you from the following frequency distributions.

1	<p>The number of chillies Costa plucked from each of the chillie plants in his garden plot is as follows.</p> <p>9 14 19 23 27 28 29 33 34 38 39 40 42 44 26 48 10 10 30 40 12 13 30 30 15 19 25 42 43 15 22 19 46 32 25 24 34 25 26 34</p>
2	<p>The number of loaves of bread sold at a shop on 35 days is as follows.</p> <p>35 18 45 60 05 41 23 42 24 90 44 48 01 10 65 65 11 06 46 71 60 60 44 81 70 50 45 80 20 31 51 30 40 31 61</p>
3	<p>The number of drawing pins left over in several packets of drawing pins that were used in a workshop is as follows.</p> <p>20 20 07 24 12 11 35 06 34 24 29 29 30 12 09 30 33 21 32 27 15 10 26 16 23 14 22 17 18 08 13 18 19 19 22</p>

- Discuss for the data set you received, whether other data could lie between two consecutive data such as 23 and 24.
- By using the text book find a name for this type of data.
- Prepare to present the frequency table you prepared to the others in the class.

(40 minutes)

**Step 3 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That the length of a frequency table can be controlled by grouping data.
- That classes into which data are grouped are defined as class intervals.
- That organizing a set of data into class intervals can be done by considering the size of the class interval that is required. That the data can also be grouped by considering the number of class intervals that is required.
- That the median of a class interval represents the data in the interval and that in this situation, this median is called the mid-value.
- That in the class interval 2 - 4, 2 is the lower limit and 4 the upper limit.

- That by the phrase “from – to” ( $a \leq x \leq b$ ), the two limits of a class interval are identified.
- That since the given data can be represented by precise values, and since no intermediate values can be found between two consecutive data points, it is called discrete data.
- That the mid-value of the range of values between the upper limit of any class interval and the lower limit of the next class interval is the upper boundary of the first class interval and the lower boundary of the next class interval.

(30 minutes)

**Step 4**

Engage the students in the activity by using the following leaflet on exploration.

<b>Leaflet on Exploration</b>	
<b>Part II</b>	
<ul style="list-style-type: none"> <li>• Group the set of data you receive from the following sets by taking class limits according to the phrase “from – to”.</li> </ul>	
1	The length of pieces of electric cable that were cut out and discarded by an electrician is as follows. (All measurements are in cm)  20.0 32.0 35.9 42.0 29.4 24.0 20.5 28.5 43.8 47.5 33.0 34.0 33.5 23.9 34.5 45.0 47.0 25.0 48.0 26.4 30.0 30.0 46.0 39.8 40.0 28.0 31.5 31.8 24.3 32.4 36.0 44.0 37.0 37.5 40.2
2	The weight of several cod fish is as follows. (All measurements are in kg)  2.0 3.7 4.0 4.5 6.4 6.0 15.0 16.0 11.0 11.0 18.0 5.8 13.0 13.5 16.4 19.0 20.0 7.0 8.0 9.0 9.0 8.1 9.5 10.0 7.9 14.1 11.5 10.3 12.0 12.0 12.8 14.0
3	The amount of time that several bulbs burnt during a test to determine the life time of a certain type of light bulb is as follows. (All measurements are in hours)  700.0 730.0 750.0 750.5 790.0 800.0 960.0 920.4 940.0 930.5 780.3 1010.0 1075.0 1150.0 800.4 850.1 900.5 950.3 1000.4 1050.5 1101.0 1150.5 950.0 950.0 920.0 900.7 900.0 865.0 850.0 875.0 820.0 1050.0 1100.0 1000.0 1200.0 880.5 975.0 970.0 840.6 990.4
<ul style="list-style-type: none"> <li>• Prepare a frequency table for the data set received by your group, by selecting a suitable number of class intervals and such that the upper limit of one class interval coincides with the lower limit of the next class interval.</li> <li>• Now discuss the difference between this set of data and the set of data you received earlier. Propose a suitable name for this set of data.</li> <li>• Prepare to present your findings at the plenary session.</li> </ul>	

(40 minutes)

**Step 5 :**

After the students' presentations, lead a discussion and highlight the following facts.

- That this data flows without a break.
- That there could be other data points between the given data in sets of data such as this.
- That here, the upper limit of each class interval coincides with the lower limit of the next class interval.
- That when data is grouped in intervals such as 10 – 15, 15 – 20, 20 – 25 etc, the boundaries of a class interval coincide with the limits of the class interval.
- That when data is entered into a table with such class intervals, it should be entered as  $a \leq x < b$ ; i.e., for example, the data which is greater or equal to 10 but less than 15 should be entered into the interval 10 – 15.
- That data of this type is called continuous data.

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Gives examples to explain the meaning of the words discrete and continuous.
- Determines the range of the set of data and decides on the size of a class interval, to group the data.
- Prepares a frequency table with class intervals for discrete as well as continuous data.
- Works as a team to produce significant results.
- Applies the principles of Statistics to justify representative values.

### 28. Data Representation and Data Interpretation II

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

**Competency Level 29.1** : Investigates frequency distributions using representative values.

**Time** : 90 minutes.

**Learning –Teaching Process:**

**Step 1 :**

- (a) The marks that a student obtained at a term test for 10 subjects are given below.  
49, 58, 65, 70, 29, 65, 76, 65, 72, 35
- (b) The marks that 20 students in a class obtained were noted down by the teacher in the following manner.

Marks (Class Interval)	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Number of Students	1	1	2	1	2	3	5	2	2	1

Present the above chart of marks and obtain the mode, median and mean of the student’s marks. Find the mid-value of each class interval of the second set of data. Lead a discussion and highlight the following facts.

- That the mode, median and mean are used as representative values.
- That the mode, median and mean of ungrouped data can be determined.
- That the mid-value of a class interval is used to represent all the data in the class interval.

(20 minutes)

**Step 2 :**

Engage the 4 groups in the activity using the following leaflet on exploration, by providing two groups each with the same frequency distribution.

### Leaflet on Exploration

The frequency distribution of the number of buns sold at a canteen on a certain number of days as well as the frequency distribution of the heights of a group of students together with the number of students is given below

Class Interval (Number of Buns)	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Number of Days	5	8	10	13	7	6	3	2	1	1

Class Interval (Height in cm)	55-60	60-65	65-70	70-75	75-80	80-85	85-90
Number of Students	1	3	6	20	5	3	2

- Examine the frequency distribution that your group received and determine the type of data it contains.
- Discuss what the modal class of the frequency distribution is.
- Discuss how the median class of the frequency distribution can be obtained and note it down.
- Draw a table of the following form and complete it by using the frequency distribution that your group received.

Class Interval	Frequency ( $f$ )	Mid-value ( $x$ )	$fx$

- Carry out a discussion and decide what value can be used to represent the total number of buns sold within the first class interval/the sum of the heights of the students whose heights belongs to the first class interval of the frequency distribution you received.
- According to the frequency distribution you received, what is the total number of days/total number of students?
- Discuss among the group how the total number of buns sold during all the days/the sum of the heights of all the students could be found and find it.
- Find the mean number of buns sold during a day/the mean height of a student.
- Prepare to present your findings at the plenary session.

(40 minutes)

**Step 3 :**

After the students' presentations, lead a discussion based on them, and highlight the following facts.

- That the modal class, median class and the mean are used as representative values for grouped frequency distributions.
- That the class interval which contains the most number/highest frequency is called the modal class.
- That the median class can be obtained by dividing the total frequency by two and determining the class interval to which the value corresponding to this belongs.
- That the mean of the distribution can be obtained by taking the product of the mid-value ( $x$ ) of each class interval and the corresponding frequency ( $f$ ), adding them up ( $\sum f \times x$ ), and dividing this sum by the sum of the frequencies ( $\sum f$ ).

(30 minutes)

**Criteria for Assessment and Evaluation:**

- Recognizes the modal class, median class and mean as representative values of a grouped frequency distribution.
- Calculates the modal class, median class and mean of a frequency distribution with class intervals.
- Makes predictions by considering the representative values of a frequency distribution.
- Makes correct decisions by analyzing information.
- Works in cooperation within the group.

## *Assessment and Evaluation*

## Introduction

In the transformation role, a role which enters at the door of the new millennium, the main goal of the teacher is to present the country with citizens who will be able to face future challenges successfully. To enable you to carry out this teaching role successfully, a student centered, competency based, activity oriented curriculum has been presented to you.

An attempt has been made in this curriculum which is implemented through a pre-determined activity continuum, to integrate assessment and evaluation with learning and teaching. The teacher is provided with the opportunity to assess the students when they are involved in exploration within groups under the second step of each activity, and then to evaluate them when they present their findings and subject the same to elaboration. Under assessment, the teacher is expected to move among the students engaged in exploration, closely observe the tasks they are involved in, help them to solve in the classroom itself any problems they happen to encounter by providing them with facilities and guidance, and take steps to ensure that every student approaches the closest level of proficiency. In addition, under evaluation, the level of proficiency that the students approach through exploration should be determined and expressed.

The two way guidance that a teacher who is involved in assessment could give to his/her students is defined as feedback and feed forward. It is the task of the teacher to provide students with feedback to overcome their learning difficulties, when the weaknesses and inabilities of the students are discovered, and to provide feed forward when the abilities and strengths are identified, to further develop these capabilities. For the continuous development of student learning, it is as important to identify and inform students of the extent to which they have been able to actualize the competency levels included in the syllabus. It is expected that through the assessment programme, the teacher will determine the proficiency level that the students have approached, and communicate their progress to the students themselves, their parents and other relevant parties.

Five common criteria are proposed to facilitate the task of assessment and evaluation. Of these criteria, the first three which are based on the subject content relevant to the competency level, are subject skills organized in order of difficulty. The final two criteria which should be developed through the learning teaching process, are two common skills which are important in the learning of any subject. The teacher should make an effort to identify the five behavioral changes related to these criteria within the classroom itself while the students are active, strengthen them under assessment, and under evaluation, make judgments and inform the students regarding their level of achievement.

This section includes learning-teaching-evaluation instruments to further improve the programme of assessment and evaluation at the school level. The first task that should be carried out is to meaningfully group the activities included in the activity continuum. Many learning-teaching-evaluation forms that can enhance student learning have been selected, based on the subject content related to the group of activities. The teacher should come forward to teach students through these forms, taking teaching and student learning outside the time table and confirming student learning through regular monitoring. It is expected that



the teacher will introduce each instrument before the commencement of the first activity in the activity group and carry out regular assessments throughout the period that the activities in the activity group are being done. Once all the activities in the activity group are completed, the students should be provided with the opportunity to present their findings and to elaborate on them on a predetermined date. The elaborations should be done as in the case of the activities, first by the group which presents the findings, then by the other groups and finally by the teacher. In instances of explanation and elaboration, during the final review, the teacher should clarify all doubts, correct any wrong ideas, cover all the factual shortcomings in the presentations, highlight the subject content on which the learning outcomes are based and express the results of the evaluation. The teacher should understand that he/she should not postpone the task of evaluation to the end, but should use the time that students engage in explanations and elaborations to carry out evaluations. When the learning-teaching-evaluation instrument is being introduced the transaction role of the teacher comes into play while at the end of the learning-teaching-assessment-evaluation process, the teacher is required to do the final elaboration under the transmission role.

The third part of the Teacher's Instructional Manual has been prepared to introduce the number of evaluations that should be carried out during the activity continuum, the learning-teaching-evaluation instruments selected to carryout each of the evaluations successfully and the types of questions that could be included in the term tests and final test under an authentic evaluation scheme. All these modernizations pave the way for teachers to further enhance the learning teaching process by augmenting the learning-teaching-assessment-evaluation process with examination questions that are based on real life situations and by carrying out assessment and evaluation at appropriate points during the activities and the groups of activities and, for students to engage in learning with interest and understanding.

## Learning-Teaching-Evaluation Instruments

### Instrument - 01

- 01. Time of evaluation** : 1<sup>st</sup> term
- 02. The competency levels covered** : 3.1, 5.1, 5.2
- 03. Relevant subject content** :
- Simplifying Fractions
    - Including brackets, 'of'
    - BODMAS
  - Percentages
    - Profit, Loss
    - Use of Percentages (discounts, commissions)
  - Simple Interest
    - Interest Rate
    - Monthly
    - Annual
  - Calculation of Interest
    - For the Amount
    - For the Period
- 04. Nature of the instrument** : • Creating a Graphic Organizer
- 05. Aims of the instrument** :
- Collects facts related to the use of fractions, percentages and simple interest in daily situations.
  - Develops relationships between the facts that have been collected.
  - Creates a Graphic Organizer which communicates the obtained information well.
- 06. Instructions to implement the instrument:**
- For the teacher** :
- Introduce this instrument to the students before commencing the activity relevant to competency level 3.1.
  - Inform the students that they should complete this instrument within a week of the completion of the activity relevant to competency level 5.2.

- Instruct the students to collect from various places, information that is relevant to the subject areas fractions, percentages and simple interest.
- Explain what a graphic organizer is.
- Group the students in a suitable manner.
- Instruct the students to consider instances involving fractions, profit, loss, discounts, commissions, interest, brokerage etc in daily life situations as well as the way they affect each individual in society and to create a graphic organizer to show the relationships that exist between these areas.
- Allocate marks according to the given criteria.

### For students

- Select the following places and individuals or other places which are convenient to gather information on the subject areas that your teacher has provided you with.
  - Home
  - School
  - Farm
  - Weekly Fair
  - Retail and Whole-Sale Stores
  - Financial Institutes (Banks etc.)
  - Co-operative Stores
  - Supermarkets
  - Those who are self-employed
  - Realtors
  - Traders who take loans for the day to conduct their daily trade.
  - Individuals with knowledge on how family property has been divided.
- When gathering information you should consider the following.
  - Daily situations in which profit/loss/discounts/ commissions/brokerage/ interest are used and how they affect individuals in the society.
  - How traders who conduct their trade by borrowing daily repay their loans each day. (The interest rate they pay on the loan)
- Get together as a group, discuss and find relationships between all the information that has been gathered.

- Create a graphic organizer which clearly explains the relationships between the various subject facts.
- Present your completed group work on the assigned date.

**07. Method of allocating marks**

**Criteria**

- :
- Gathers daily life information with a sensitiveness towards the environment.
  - Investigates how profit, loss, discounts, commissions and brokerage affect individuals conducting transactions.
  - Communicates information through a Graphic Organizer.
  - Presents a high quality product.
  - Completes the work by the assigned date.

**Marks range**

:

Very Good	04
Good	03
Average	02
Should Improve	01

**Instrument - 02**

- 01. Time of evaluation** : 1<sup>st</sup> term
- 02. The competency levels covered** : 14.1, 14.2 and 15.1
- 03. Relevant subject content** :
- Algebraic Expressions
    - Substitution
    - Products of Binomial Expressions of the form  $(x \pm a)(x \pm b)$  ( $a, b \in Z$ )
  - Factors of Algebraic Expressions
    - Up to Four Terms, with Common Factor a Binomial Expression
    - Of the form  $x^2 + bx + c$  ( $b, c \in Z, b^2 - 4c$  is a perfect square).
  - Difference of Two Perfect Squares
- 04. Nature of the instrument** :
- An Investigative Study
- 05. Aims of the instrument** :
- Writes down several different products of two binomial expressions.
  - Presents how a product of two binomial expressions of the form  $(x \pm a)(x \pm b)$  may be written directly.
  - Easily factors a trinomial quadratic expression of the form  $x^2 + bx + c$  by considering  $b$  and  $c$ .
  - Describes the nature of a quadratic expression of the form  $x^2 + bx + c$  and its factors when  $b = 0$ .
  - Presents instances in the subject of Mathematics when simplification is facilitated by using the difference of two squares.
  - Presents an investigative report on expressions of the form  $x^2 + bx + c$ .
- 06. Instructions to implement the instrument:**
- For the teacher** :
- Introduce this instrument to the class at the commencement of the activity relevant to competency level 14.1.
  - Divide the class into small groups of two students each.

- Inform the class that both students in each group have to be involved in the whole instrument.
- Inform the students that the task ends with the completion of the table and the preparation of a report based on an investigation of the information in the table.
- Inform the students that the report should be handed over within a week of the completion of the activity relevant to competency level 15.1

**For the students**

- Express the product  $(x \pm a)(x \pm b)$  as four different trinomial quadratic expressions of the form  $x^2 + (\dots)x + (\dots)$ .
- Select any 10 pairs of integral values for  $a$  and  $b$ .
- Complete the following table by forming 10 trinomial quadratic expressions under each of the 4 different cases, by substituting the 10 pairs of values for  $a$  and  $b$  into the four trinomial quadratic expressions you obtained above.

Situation	Pair of Numbers		Trinomial Quadratic Expression	Factors
	$a$	$b$		
1. $x^2 + (\dots)x + (\dots)$	.....	.....	i.	
	.....	.....	ii.	
	.....	.....	.	
	.....	.....	.	
	.....	.....	.	
	.....	.....	x.	
2. $x^2 + (\dots)x + (\dots)$	.....	.....	i.	
	.....	.....	ii.	
	.....	.....	.	
	.....	.....	.	
	.....	.....	x.	
3. $x^2 + (\dots)x + (\dots)$	.....	.....	i.	
	.....	.....	ii.	
	.....	.....	.	
	.....	.....	.	
	.....	.....	x.	
4. $x^2 + (\dots)x + (\dots)$	.....	.....	i.	
	.....	.....	ii.	
	.....	.....	.	
	.....	.....	.	
	.....	.....	x.	

- Complete the table by writing the factors of each quadratic expression.
- Investigate the relationships between the expressions in each row of the table.
- Write down 10 algebraic expressions such that the sum of  $a$  and  $b$  is 0. Factor these expressions.
- List the special properties of these algebraic expressions.
- Propose a name for such expressions.
- With examples, present situations in the subject area Mathematics, in which the above type of expressions and their factors are used to facilitate simplification.

**07. Method of allocating marks :**  
**Criteria**

- Completes the table by finding out facts in accordance with the given instructions.
- Develops new ideas by investigating the information in the table.
- Presents situations in which the developed facts can be used.
- Prepares an accurate and instructive report based on the facts that were discovered through the investigation.
- Presents the report within the allocated time.

**Marks range :**

Very Good	04
Good	03
Average	02
Should Improve	01

**Instrument - 03**

- 01. Time of evaluation** : 1<sup>st</sup> term
- 02. The competency levels covered** : 21.1 and 21.2
- 03. Relevant subject content** :
- Proof and Application of the Theorem:  
The vertically opposite angles formed by the intersection of two straight lines are equal.
  - Application of the following Theorem and its Converse:  
If a transversal cuts a pair of straight lines such that
    - the corresponding angles formed are equal to each other, or
    - the alternate angles formed are equal to each other, or
    - the sum of a pair of allied angles equals two right angles, then  
the two straight lines are parallel to each other.
- 04. Nature of the instrument** : An investigative study.
- 05. Aims of the instrument** :
- Draws various geometrical figures by using several straight line segments.
  - Writes down various geometric relationships between the angles formed by the intersection of straight lines.
  - Identifies the angles related to parallel lines and writes down the relationships between them.
- 06. Instructions to implement the instrument:**
- For the teacher** :
- Introduce this instrument to the students before the commencement of the lesson on the angles related to straight lines.
  - Divide the class into groups of 3 students each.
  - Observe how the groups carry out the instructions that were given and assess them.
  - Inform the students of the date on which their completed work should be handed over, collect the work on the assigned date and allocate marks according to the given criteria.



**For the students**

- : • Draw ten different figures for each of the following three cases:
  - Using 2 straight line segments
  - Using 3 straight line segments
  - Using 4 straight line segments
 and such that they intersect.
- Name the straight line segments and the intersection points in each figure.
- Write down as many geometric relationships as you can between the angles in each figure.
- Draw three parallel straight lines segments and draw two transversals such that they intersect all three lines.
- Name the parallel lines segments, the transversals and the intersection points in the above drawn figure.
- Write down as many geometric relationships as you can between the angles in the above figure. (You should write at least 20 relationships)
- Present your work with clarity on the date assigned by the teacher.

**7. Method of allocating marks  
Criteria**

- : • Draws at least 30 different figures using straight line segments.
- Writes down various geometric relationships that exist between the angles formed by the intersection of straight line segments.
- Writes down the geometric relationships that exist between the angles related to parallel lines.
- Works with team spirit and enthusiasm within the group.
- Ensures that the completed work is presented with clarity and neatness.

**Marks Range**

- :
 

Very Good	04
Good	03
Average	02
Should Improve	01

**Instrument - 04**

- 01. Time of evaluation** : 2<sup>nd</sup> term
- 02. The competency levels covered** : 4.1 and 20.1
- 03. Relevant subject content** :
  - Direct Proportions
  - Graphs
- 04. Nature of the instrument** :
  - Wall Newspaper
- 05. Aims of the instrument** :
  - Engages in calculations using direct proportions.
  - For a given domain, graphs equations of the form  $y = mx$ .
  - For a given domain, graphs equations of the form  $y = mx + c$ .
  - Writes down the gradient and the intercept by considering the graph.

**06. Instructions to implement the instrument:**

**For the teacher**

- Divide the class suitably into groups and introduce this instrument before commencing the activity relevant to competency level 4.1.
- Inform the students that the information should be collected individually and presented as a group.
- Provide instructions to collect the relevant information and to present it in a suitable manner.
- Allocate marks according to the given criteria.

**For the students**

- Collect information which the media issues daily regarding the exchange rate of foreign currencies.
- Using this information, note down in the following table the value in Sri Lankan rupee corresponding to the given U.S. dollar values.

**Table I**

$x$ (Dollar)	1	2	3	4	5	6	7	8	9	10
$y$ (Rupees)										

- In the same manner, prepare tables for the Sterling Pound and the Euro.
- Plot all three relationships on the same coordinate plane according to the information in the tables. (The graph paper should be a large one)
- Discuss within the group regarding the properties of the graph, how it can be used and its importance.
- Using your graph
  - represent the value of an amount given in Sri Lankan rupees in terms of the other currencies.
  - indicate the value of a fixed amount of the other three currencies in terms of the Sri Lankan rupee.
- There are two units of measurements of temperature, namely centigrade and Fahrenheit. The relationship  $F = 32 + \frac{9}{5}c$  is obtained by denoting centigrade by  $c$  and Fahrenheit by  $F$ .
- Prepare a table of values to graph this equation. Take the  $x$ -axis as the temperature in centigrade and the  $y$ -axis as the temperature in Fahrenheit and plot the graph.
- Discuss regarding the type of straight line your graph is.
- By considering your graph, have a discussion regarding the gradient and the slope of the straight line.
- By using the graph, convert several measurements of temperature in one unit into measurements in the other unit.
- Include all the above facts and prepare an information chart suitable for a wall newspaper.

**07. Method of allocating marks :**

**Criteria**

- Collects data according to the given instructions.
- Tabulates the information that was collected.
- Graphs the information that has been tabulated.
- Reaches conclusions based on the graph.
- Works with enthusiasm within the group and hands over the completed work on the assigned date.

**Marks range :**

Very Good	04
Good	03
Average	02
Should Improve	01

**Instrument - 05**

**01. Time of evaluation** : 2<sup>nd</sup> term

**02. The competency levels covered** : 27.1, 27.2 and 23.4

**03. Relevant subject content** :

- Construction of the Four Basic Loci
- Construction of Angles of 60°, 90°, 30°, 45° and their Multiples.
- Recognizing Pythagoras' Relation and using it. (For integral values)

**04. Nature of the instrument** : Creation of a Display Item.

**05. Aims of the instrument** :

- Constructs the necessary shapes by applying the knowledge on loci.
- Engages in a construction by using the knowledge on angles.
- Produces a high quality creation suitable for display.

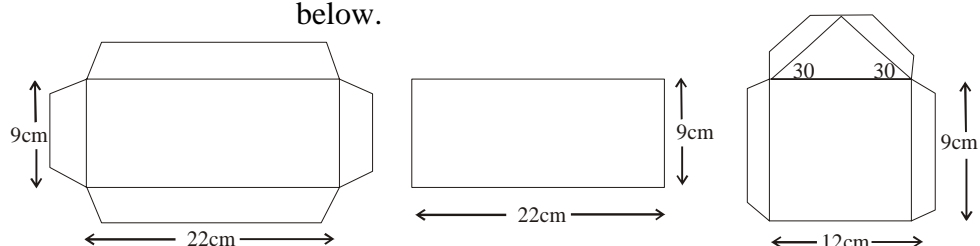
**06. Instructions to implement the instrument:**

**For the teacher**

- Introduce this instrument and the criteria for allocating marks at the commencement of the activity relevant to competency level 27.1.
- Group the students in a suitable manner.
- Help the students to prepare the nets.
- Inform the students that they should handover the completed work within a week of the completion of the activity relevant to competency level 23.4.
- Provide the required cardboard, pairs of scissors, gum and thread as quality inputs.
- Allocate marks according to the given criteria.

**For the students**

- Get together in your groups and divide the work between the members.
- Carefully study the three sketches of nets given below.



- Using two nets of each type, draw and cut out six nets with the given measurements and with the allowance for pasting.
- Prepare a model of a house by using the nets in a suitable manner.
- Attempt to add new aspects to the creation without altering the initial model.
- Cut out a piece of cardboard of length 40cm and breadth 30cm.
- Paste the model of the house on this piece of cardboard such that the back wall of the house is parallel to the side which is 40cm long and is located at a distance of 8cm from it.
- Draw a piece of thread between the back boundary and the back wall of the house, at an equal distance from each.
- In a suitable manner, place a circular well of radius 3cm in front of the house.
- Make the model you constructed attractive and suitable for display.
- Propose a method to find the distance from one front corner of the house to the back corner of the house which lies diagonally across. Thereby find this distance.
- On the assigned date, present your creation and the information you discovered to the class.

**07. Method of allocating marks :**

**Criteria**

- Uses the four basic loci accurately.
- Accurately constructs angles of  $60^\circ$ ,  $90^\circ$ ,  $30^\circ$ .
- Applies Pythagoras' relationship accurately.
- Presents a creative display item.
- Hands over the completed work on the assigned date.

**Marks Range**

Very Good	04
Good	03
Average	02
Should Improve	01

**Instrument - 06**

- 01. Time of evaluation** : 2<sup>nd</sup> term
- 02. The competency levels covered** : 17.1, 17.2. and 19.1
- 03. Relevant subject content** :
- Solving Simple Equations
    - With Two Types of Brackets
    - With Fractions
  - Changing the Subject of Simple Formulae (Without powers and roots)
  - Simultaneous Equations
    - The coefficient of one unknown is numerically equal in both equations.
- 04. Nature of the instrument** :
- An Analytical Study
- 05. Aims of the instrument** :
- Picks equations and formulae from books.
  - Expresses that a simple equation contains only one unknown.
  - Converts a given variable into the subject of the formula.
  - Converts a given equation into a formula by changing one unknown into the subject.
  - Presents a method of solving a pair of simultaneous equations by converting one unknown into the subject.
- 06. Instructions to implement the instrument:**
- For the teacher** :
- Introduce this instrument to the students before commencing the activity relevant to competency level 17.1.
  - Form groups of four students each.
  - Instruct the students to obtain the Mathematics and Science textbooks of grades 6 to 9.
  - Engage the students in the activity with the aid of the textbooks and assess them as they work.
  - Collect the students completed work within a week of completing the activity relevant to competency level 19.1 and allocate marks according to the given criteria.

**For students**

- In accordance with the teacher's instructions, prepare a list of equations that are found in the Mathematics and Science textbooks for grades 6 to 9. (The list should contain at least 20 equations)
- Classify these equations as follows.
  - Without brackets
  - With one bracket
  - With two brackets
  - With fractions
  - With one variable
  - With two variables
  - With more than two variables
- From the list, separate out the equations that can be considered as formulae.
- From the formulae you separated out, select 5 formulae **without powers or roots** and convert each unknown in each formula into the subject of the formula and re-write the equations.
- Re-write the following equations such that the same unknown is the subject of the two equations.
 
$$x + y = 7$$

$$x - 2y = 1.$$
- Thereby obtain the solution of the pair of equations.
- Present a method of solving pairs of simultaneous equations by converting one unknown into the subject of the two equations.
- Prepare a report which includes the information that you gathered as well as discovered and hand it over to the teacher on the assigned date.

**07. Method of allocating marks****Criteria**

- Gathers information which includes at least 20 equations.
- Separates out and writes down the equations which are formulae.
- Converts each unknown in 5 of the selected formulae into the subject of the formula.
- Solves a pair of simultaneous equations by converting one of the unknowns into the subject of the two equations.
- Works with enthusiasm and cooperation throughout the process.

**Marks range**

:

Very Good	04
Good	03
Average	02
Should Improve	01



**Instrument - 07**

- 01. Time of evaluation** : 3<sup>rd</sup> term
- 02. The competency levels covered** : 30.1 and 31.1
- 03. Relevant subject content** : • Sets
- Finite Sets
  - Subsets of a Set
  - Complement of a Set
  - Set Operations
    - Intersection
    - Union
  - Probability
    - Randomness
    - Sample Space
    - Probability (Of equally likely events)
- 04. Nature of the instrument** : • Preparing a Survey Report
- 05. Aims of the instrument** : • Writes down several sets related to the school community.
- From a collection of sets, selects and pairs off sets with common elements.
  - Describes in words the complement of a set and the intersection and union of two sets.
  - Calculates the probability by considering equally likely events.
  - Prepares a report on a survey carried out in connection with the school.
- 06. Instructions to implement the instrument:**
- For the teacher** : • Introduce this instrument to the students before commencing the activity relevant to competency level 30.1, and inform the students regarding the criteria for the allocation of marks.
- Group the students in a suitable manner
  - Inform the students that the completed work should be handed over within a week of the completion of the activity relevant to competency level 31.1.
  - Allocate marks according to the given criteria.

**For the students**

- : • Focus your attention on the following aspects related to your school and write down in words 15 sets which can be identified which include students who are involved in these aspects. Name the sets as A, B, .....
- Sports
- Aesthetic Studies
- IT
- Various Groups
- Societies, Associations
- Method of Transport to School
- Other
- For each of the 15 sets write down,
  - the complement in words
  - two subsets each in terms of the elements
- From the 15 sets, select 5 pairs of sets with non-empty intersection and write down in words,
  - the intersection set
  - the union set
- A certain institute intends to provide a student in your school with a scholarship. The criterion that has to be satisfied for eligibility is that the student should either be a prefect or should hold an official position in a society.
- By considering the two sets formed by the criterion, determine the probability of a student in your school obtaining the scholarship.
- Find the probability of a student who is either a leader or who holds an official position in a society obtaining the scholarship.
- Prepare a report containing the information gathered from the commencement of the instrument and hand it over to the teacher on the assigned date.

**07. Method of allocating marks  
Criteria**

- : • Writes down 15 different sets which can be identified within the school.
- Describes in words the complement of the 15 sets and, for 5 selected pairs of sets with non-empty intersection, the intersection and union of each pair.
- Makes decisions in daily activities by applying the knowledge on sets.
- Works with an awareness of the activities associated with one's environment.
- Works with patience to gather accurate information.

**Marks range**

:

Very Good	04
Good	03
Average	02
Should Improve	01

**Instrument - 08**

- 01. Time of evaluation** : 3<sup>rd</sup> term
- 02. The competency levels covered** : 8.1, 8.2 and 10.1
- 03. Relevant subject content** :
- The Area of Plane Figures
    - Parallelogram
    - Trapezium
    - Circle
  - Surface Area of a Right Prism with a Triangular Cross-section
  - Volume of a Prism
    - With a Triangular Cross-Section (Equilateral, Isosceles, Right-angled)
    - With a Quadrilateral Shaped Cross-Section (Squares, Rectangles)
- 04. Nature of the instrument** :
- An Explorative Study
- 05. Aims of the instrument** :
- When the area of a plane figure such as a parallelogram, a trapezium, a triangle or a circle is given, writes down all the possible integral values of the measurements that are necessary to find the area.
  - Proposes possible integral values for the measurements required to find the volume, when a value is given for the volume of a prism with
    - i. a square
    - ii. a rectangular
    - iii. a right triangularcross-section.
  - Calculates the surface area of a prism when the measurements are known.
  - Expresses that different prisms can have different surface areas even if the volume of the prisms is the same.
  - Relates the information that is discovered and prepares a report.

**06. Instructions to implement the instrument:****For the teacher**

- : • Introduce this instrument to the students before the commencement of the activity relevant to competency level 8.1.
- Divide the class into groups such that the number of groups is a multiple of 4 and such that each group contains no more than 4 students.
- Inform the students that this instrument is to be carried out in two stages and that they should finally prepare a report containing all the information that is discovered throughout the whole activity.
- Distribute the following numbers among the groups.

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>Stage 1</b>	<b>120</b>	<b>84</b>	<b>96</b>	<b>72</b>
<b>Stage 2</b>	<b>144</b>	<b>256</b>	<b>320</b>	<b>360</b>

- Guide the students towards writing 5 sets of required measurements to find the area of a parallelogram, a trapezium, a triangle and a circle that has as its area the value given in the first stage.
- Guide the students towards writing the integral valued measurements of a prism with a square, rectangular or right triangular cross-section that could have as its volume the value given in stage 2.
- Assess the students as they engage in the process.
- Inform the students that the completed work should be handed over within a week of the completion of the activity relevant to competency level 10.1.
- Collect the completed work on the assigned date and allocate marks according to the given criteria.

**For students**

- : • Complete the following table by finding at least 5 sets of measurements for each plane figure, which give an area that is equal to the value you obtained under stage one.

- If necessary, use a calculator to perform the calculations.

Figure	Sketch with measurements included	Set of measurements
Parallelogram		
Trapezium		
Triangle		
Circle		

- Examine how many different parallelograms you can draw using **just one** set of measurements of the parallelogram.
- In the same manner, find out how many figures can be drawn with each of the other sets of measurements too.
- What are the special facts you discovered in relation to the circle?
- Note down the facts you discovered through the above investigation.
- Write down all the integral valued measurements of a prism with the following cross-sections that has as its volume the value given to your group in stage 2.
  - Cross-section
    - Square
    - Rectangle
    - Right-angled triangle
- Using the measurements you obtained, calculate the surface area of each prism.
- Discuss whether the surface area of different prisms is equal when the volume is equal.
- Organize your discoveries creatively and hand it over on the assigned date.

**07. Method of allocating marks**

:

**Criteria**

- Writes down the relevant measurements of various plane figures that have the same area.
- Writes down the relevant measurements of prisms with given cross-sections that have the same volume.
- Determines the surface area of a prism when the measurements are known.
- Compares the information that is discovered and expresses ideas about various relationships.
- Works with team spirit to present a creative and accurate product.

**Marks range**

:

Very Good	04
Good	03
Average	02
Should Improve	01

**Instrument - 09**

- 01. Time of evaluation** : 3<sup>rd</sup> term
- 02. The competency levels covered** : 28.1 and 29.1
- 03. Relevant subject content** :
- Type of Data
    - Continuous
    - Discrete
  - Representation of a Frequency Distribution (Grouped Data)
    - Limits and Boundaries
    - Mid-value
  - Of Grouped Data
    - The Modal Class
    - The Median Class
    - The Mean
- 04. Nature of the instrument** : • A Short Term Project
- 05. Aims of the instrument** :
- Decides on the number of class intervals by considering the range of the data.
  - Groups the data according to the class intervals and prepares a frequency table.
  - Uses the mid-value to represent a class interval.
  - Analyses the data and determines the modal class, the median class and the mean of a grouped frequency distribution.
  - Reaches conclusions by considering the representative values.
  - Prepares a report by analyzing the numerical information.
- 06. Instructions to implement the instrument:**
- For the teacher** :
- Introduce this instrument to the students before commencing the activity related to competency level 28.1.
  - Inform the students that the activity ends with the small groups working together and preparing a report.



- Divide the class into groups of no more than four students each and give each group one of the four subjects Science, Mathematics, Sinhala, English.
- Provide the students with the Marks Book to enable them to gather the required information. (If the class has only a few students guide them to gather the information related to all the students in the school)
- Inform the students that the report should be handed over a week after the completion of the activity relevant to competency level 29.1.
- Allocate marks according to the given criteria.

### For the students

- Your Principal requires a report on the performance level and progress of the students in each class, for the 4 different subjects. Aid the Principal in this task by following the process given below.
  - Collect the marks which the students in your class obtained during the last term test for the subject assigned to your group.
  - Prepare a frequency table with 8 equal length class intervals such that the above data can be entered in it.
  - Enter the marks of the students into the table you prepared and extend the table by including the mid-values obtained by considering the class limits and boundaries of each class interval.
  - Determine the modal class, the median class and the mean of the marks.
  - Obtain the mean value of the marks for the other subjects from the other groups, compare these values and prepare a report on the difference in the performance levels.  
(When preparing the report, consider the difference between the representative values obtained for the different subjects for the same group of students)

**07. Method of allocating marks**

:

**Criteria**

- Prepares a frequency table with class intervals such that the data can be included in it.
- Obtains the modal class, the median class and the mean by using the frequency table.
- Statistically explains the anomaly in the performance level of a group of students with respect to different subjects.
- Discovers important facts and prepares the report creatively.
- Exchanges ideas and works in cooperation.

**Marks range**

:

Very Good	04
Good	03
Average	02
Should Improve	01

### List of Quality Inputs

- Demy Papers
- Marker Pens/Pastels
- Gum
- Pairs of Scissors
- Bristol Boards
- Half Sheets
- Oil Papers
- Calculators
- Pins
- Sets of Geometrical Instruments
- Vessels Calibrated in  $\text{cm}^3$  and ml
- Two Rupee Coins, Lids of Milk Tins, Small Saucepans, Tumblers with a Uniform Cross-section, Salmon Tins, Jam Bottles, Bicycle Rims, Bangles
- Graph Papers
- Grids with  $1\text{cm} \times 1\text{cm}$  Squares on Transparent Sheets
- Solid Prisms/Cubes/Cuboids
- Clinometer