Mathematics
Grade 8

Introduction

Mathematics involves observing, representing and investigating patterns and relationships in social and physical phenomena and between mathematical objects themselves. Mathematics learning should develop students' abilities to:-

- See the mathematics in situations and choose appropriate mathematics for these situations.
- Think creatively, critically, strategically and logically.
- Plan, investigate, make conjectures and decide on levels of accuracy.
- Reason inventively, analyse options and consider the consequences and implications of decisions.

The following table outlines suggestions how the principles of effective learning and teaching can be incorporated into the learning of mathematics at grade 8 level in ways which take account of the students' current stages of development.

Principles of Learning	***Strategies Teachers can use to Implement the Principles***
Opportunity to learn Learning experiences should enable students to observe and practise the actual processes, products, skills and values which are expected of them.	• Use 'think - aloud' strategies to model mathematical processes and problem solving for students. • Provide opportunities for students to describe, explain or justify. • Provide opportunities for students to use mathematics in problem solving, pattern finding and decision making situations. • Provide opportunities for students to gain experience with the process of working mathematically. • Ensure students have the opportunities to develop confidence in applying mathematical skills in a variety of contexts.
Connection and Challenge Learning experiences should connect with students' existing knowledge, skills and values while extending and challenging their current ways of thinking and acting.	• Make links between the mathematics being taught and students' background knowledge and personal contexts. • Connect the mathematics being taught to students' learning in other curriculum areas. • Challenge students by requiring them to adopt Mathematics procedures to a range of different situations and contexts. • Provide access to ICT, illustrating mathematical potential and limitations to these. • Illustrate the way in which mathematics has been subject to challenge and change.
Action and Reflection Learning experiences should be meaningful and encourage both action and reflection on the part of the learner.	• Provide opportunities for students to discuss successful and unsuccessful mathematical strategies. • Provide opportunities for students to reflect on and discuss their progress in mathematics • Make mathematics assessment criteria explicit and create opportunities for self assessment.

Principles of Learning	***Strategies Teachers can use to Implement the Principles***
Motivation and Purpose Learning experiences should be motivating and their purpose clear to the student.	• Illustrate the real life applications and future uses of the mathematics that students are learning. • Connect learning in mathematics to students' lives and local environments. • Connect learning in mathematics to further education and career pathways.
Inclusivity and Purpose Learning experiences should respect and accommodate differences between learners.	• Design mathematical activities which cater for different learning styles, values, gender, abilities, interests, cultures, and family backgrounds. • Design Mathematical activities which take into account students' differing physical, mental and emotional development.
Independence and Collaboration Learning experiences should encourage students to learn both independently and from and with others.	• Design learning experiences that allow students some autonomy over how they learn and how they approach mathematics tasks. • Design learning experiences which allow students to work collaboratively with other students in mathematics.
Supportive Environment The school and classroom setting should be safe and conducive to effective learning.	• Build a safe classroom climate based on mutual respect and tolerance. • Encourage students to take appropriate risks in Mathematics. • Actively recognize achievement and progress in mathematics. • Treat mistakes as opportunities for learning, rather than signs of failure. • Promote school policies which support positive attitudes towards mathematics.

It is believed that at this early adolescence period students' progress significantly from concrete to abstract. The breadth and depth of mathematics content to be taught increases, with a broadened focus on the development and application of understandings. Early adolescent learners commence their journey into the world of universal ideas where they learn about the processes of discovery and the implications of change. They successfully complete activities focusing on problem solving.

Students at this grade level typically begin to move from reflecting on local and real world experiences to considering increasingly complex and abstract mathematical concepts and ideas. They value opportunities to explore new ideas in depth and commonly in cooperation with their peers.

Learning objectives for Grade 8

After completing grade 8, students should be able to:-

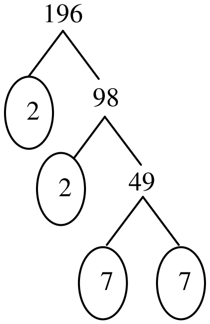
- Simplify algebraic expressions.
- Solve real life problems using variables.
- Multiply binomial by monomial and binomial.
- Determine highest common factor of algebraic expressions.
- Solve linear equations and inequalities by using rules of transformation.
- Draw a line through the origin whose equation is given.
- Determine the equation of a line that contains points whose coordinates are given.
- Determine the squares and cubes of numbers.
- Determine square roots and cube roots of perfect squares and perfect cubes respectively.
- Extract approximate square roots of numbers by using the numerical table.
- Give the conditions for triangles to be similar.
- Apply the tests for similarity to check whether two given triangles are similar or not.
- Give the relationships that exist between lines and circles.
- Apply basic facts about central and inscribed angles and angles formed by intersecting chords to solve related problems.
- Identify certain, uncertain and impossible outcomes.
- Describe event, sample space and probability of simple events.
- Calculate probabilities of simple events.
- Understand basic concepts about right angled triangles
- Apply important theorems on right angled triangles to solve related problems.
- Have a knowledge of the basic principles of trigonometric ratios.
- Apply the trigonometric ratios for 30^0, 45^0 and 60^0 to solve related problems
- Identify different parts of pyramids and cones.
- Prepare models of pyramids and cones.

Unit 1: Squares, square roots, cubes and cube roots *(20 periods)*

Unit Outcomes: Students will be able to:

- understand the notion square and square roots and cubes and cube roots
- determine the square roots of the perfect square numbers
- extract the approximate square roots of numbers by using the numerical table.
- determine cubes of numbers
- extract the cube roots of perfect cubes.

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
Students will be able to: • calculate the square of a number	***1. Squares, square roots, cubes and cube Roots*** **1.1 The squares of a number** *(5 periods)* **1.1.1 Square of a rational number**	• Guide the students to revise when a number is multiplied by it self, the result is x^2. That is $x.x = x^2$ (x the power of 2) • Avoid the misunderstanding that a^2 will be interpreted as 2a. **Example**: $3 \times 3 = 3^2 = 3$ square $= 9$	• Ask students orally to read and give meanings of the squares of numbers.
• find squares from a table of squares	**1.1.2 Use of table of values of squares**	• Lead students to conclude that squaring a number means to multiply the number by itself, example: $5^2 = 5 \times 5 = 25$ Guide the students to find square of a number from the numerical table. **Example**: Find the square of 4.72 1. Find 4.7 under the column "x" 2. move to the right until you get the number 2 3. Read the number. That is 22.28 If you multiply 4.72 you will have $(4.72)^2 = 22.2784$ • Guide students to conclude the result obtained from numerical table is an approximation for what they computed, i.e. (4.72)2 = 22.2784 ≈ 22.28 in the table.	• Ask your students to find the square of a number a) by computing b) by using table of square
• define the square root of a non-negative rational number • calculate the square root of perfect squares.	**1.2 The square root of a rational number** *(8 periods)* **1.2.1 Square roots of perfect squares**	• Start the lesson by revising squaring a number. • Assist students to explain the relation between squaring and extracting square root with examples like 2 squared = $2 \times 2 = 4$ ∴ The square root of 4 is 2 3 square = $3 \times 3 = 9$	

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
		$\therefore$ The square root of 9 is 3 5 squared $= 5 \times 5 = 25$ $\therefore$ The square root of 25 is 5 • Lead students to conclude that finding the square roots of numbers is the reverse of finding square of a number. • Define the square root of a number as follows. if y ($y \geq 0$) is the square of a non-negative number x ($x \geq 0$), then x is called the square root of y. This can be written symbolically as $x = \sqrt{Y}$ • Guide the student to use prime factorization to find the square root of perfect squares you may use examples like Find $\sqrt{196}$ $196 = 2 \times 2 \times 7 \times 7$  • Now arrange the factors so that 196 is a product of two identical sets of prime factors $196 = (2 \times 7) \times (2 \times 7)$ So $196 = 14 \times 14 = 14^2$ $\therefore \sqrt{196} = \sqrt{14^2} = 14$ **Remark**: Table of squares and square roots should be included in the text books.	
• extract the square root of a number by using square root table.	**1.2.2 Using the square root table**	• Explain the procedure, necessary for reading the root from numerical table. **Example**: To find $\sqrt{24.50}$ 1. Lead the students to find the number 24.50 from the square root table. 2. Guide the students to move on the raw of this number to left and read 4.9. These are the first two digits of the square root of 24.50. 3. To get the third digit lead the students to start from 24.50 and move vertically upward and read 5. Therefore, $\sqrt{24.50} = 4.95$ • Let students be informed that if they cannot get the number	• Give questions on how to find square root of non-negative numbers from the table of squares • Ask students to give square root of a non-negative number using table of square roots.

<table>
<tr><th><i>Competencies</i></th><th><i>Content</i></th><th><i>Teaching / Learning activities and Resources</i></th><th><i>Assessment</i></th></tr>
<tr><td></td><td></td><td>in the given table, they shall take the square root of the number which is nearest to the given number.
Example Find $\sqrt{9.950}$
1. Guide the students to find the number 9.950 from the table Since 9.950 is not found in the table, find two numbers which are nearest to it one from left and one from right that means,
$9.922 < 9.950 < 9.986$
2. Assist student to find the nearest number from those two numbers. So the nearest number is 9.922.
$\sqrt{9.950} \approx \sqrt{9.922} = 3.15$
• Guide the students to find the square root of a number greater than 100 in the following manner.
Eg. $\sqrt{2841} = \sqrt{28.41 \times 100}$
$= \sqrt{28.41} \times \sqrt{100}$
$= 5.33 \times 10$
$= 53.3$
Remark: Help students to write the given number as a product of a number and multiple of 100.</td><td></td></tr>
<tr><td>• define the cube of a number.
• determine the cubes of numbers.</td><td>1.3 Cubes and cube roots
<i>(7 periods)</i>

1.3.1 Cube of a number</td><td>• Assist students to revise the meaning of a^3 as $a \times a \times a$ which is called "the cube of a"
• Guide students to find some cubes of whole numbers using a table as follows
<table>
<tr><td>x</td><td>-4</td><td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>x^3</td><td>-64</td><td>-27</td><td>-8</td><td>-1</td><td>0</td><td>1</td><td>8</td><td>27</td><td>64</td></tr>
</table>
• Lead students to come to a conclusion that "To find a cube of a number multiply the number by itself three time."</td><td>• Ask students to find cubes of numbers (include some simple fractions and decimals)</td></tr>
<tr><td>• define the cube root of a number
• determine the cube roots of perfect cubes.</td><td>1.3.2 Cube root of a number</td><td>• Assist student to find the cubes of a number and the cube root of a number in the reverse direction
Example: $5^3 = 5 \times 5 \times 5 = 125$
The cube root of 125 is 5 because $5 \times 5 \times 5 = 125$
• Encourage students to define the cube root of a number as the product of three identical factors and take one of the</td><td>• Give problems (exercises) for your students to find cube root of numbers (perfect cubes)
Check whether the</td></tr>
</table>

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
		factors. • Assist student to write the cube of a number with the symbol "$\sqrt[3]{\ }$ " • $\sqrt[3]{8}$ read as "cube root of 8" • Encourage students to find the cube root of perfect cube. **Example** 1. $\sqrt[3]{27} = \sqrt[3]{3 \times 3 \times 3}$ 2. $\sqrt[3]{\frac{64}{125}} = \sqrt[3]{\frac{4 \times 4 \times 4}{5 \times 5 \times 5}} = \frac{4}{5}$ • Assist students to do problems like **Example**: If the volume of a cube is 8cm^3. Find the length of its edge. → To find the length of edge of a cube express 8 as a product of three identical factors and take one of the factors. $\sqrt[3]{8} = \sqrt[3]{2 \times 2 \times 2} = 2\ cm$ Therefore the length of each edge is 2cm.	students understand and apply the symbol ($\sqrt[3]{\ }$) for cube root correctly

Unit 2: Further on working with variables *(25 periods)*

Unit Outcomes: Students will be able to:

- solve life related problems using variables
- multiply binomial by monomial and determine the product of binomials
- determine highest common factor of algebraic expressions.

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
Students will be able to: • use variables in expressing algebraic and geometric relations.	***2. Further on working with variables*** **2.1 Further on algebraic terms and expressions** *(8 periods)* **2.1.1 Use of variables in formula**	• Revise the concept of variables, terms and expressions • Encourage students to discuss about the role of variables in mathematics with the help of examples. • Lead students to describe mathematical relations by means of variable. **Examples**: - The area of rectangle - Perimeter of a trapezium	• Ask students to change simple word problems in to mathematical expressions
• simplify algebraic expressions with and without brackets.	**2.1.2 Variables, terms and expressions**	• Revise the concepts like terms and unlike terms. • Guide students to simplify given expressions by collecting like terms. **Example**: Simplify $5x + y - 3x + 2y$ $5x$ and $3x$ are like terms with $5x - 3x = 2x$ y and $2y$ are like terms with $y + 2y = 3y$ $5x + y - 3x + 2y = 2x + 3y$	• Give exercises on simplification of algebraic expressions involving brackets
• solve life related problems using variables	**2.1.3 Use of variables to solve problems**	• Assist students to solve life related problems using variables. **Example**: Three children share 3600 Birr. If two get the same amount and the other gets 600 Birr more. Find the share of each. Let the share of one of the two children be x, then the share of the third child is x + 600. then $x + x + (x + 600) = 3600$ $3x + 600 = 3600$ $3x + 600 - 600 = 3600 - 600$ $3x = 3000$ $\frac{3x}{3} = \frac{3000}{3}$	• Give exercises on problems from real life that can be expressed using variables.

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
		$\therefore$ The share of the two children is 1000 Birr each and the share of the third child is 1600 Birr.	
• determine the product of monomial by binomial	**2.2 Multiplication of binomials** *(7 periods)* **2.2.1 Multiplication of monomial by binomial**	• Encourage students to simplify algebraic expressions. eg. 1) 4(x + 3) means 'four lots of x + 3' $x + 3 + x + 3 + x + 3 + x + 3$ $= x + x + x + x + 3 + 3 + 3 + 3$ $= 4x + 12$ eg. 2) Simplify $2x(3y - 5x)$ $= 2x.3y - 2x.5x$ $= 6xy - 10x^2$ eg. 3) Simplify $8x(4y + 3x)$ $= 8x.4y + 8x.3x$ $= 32xy + 24x^2$ • Lead students to reach at the conclusion that $a(b + c) = ab + ac$	• Let students find products of monomial and binomial by giving them class works and home works.
• determine the product of binomials	**2.2.2 Multiplication of biomial by binomial**	• Guide students in using law of distributivity to obtain the product of two binomials. $(a + b) \times (c + d) = a \times c + a \times d + b \times c + b \times d$ • Lead students to practice simplifying products **Example**: $(2x - y)(5m - 3n)$ $= 2x.5m - 2x.3n - y.5m + y.3n$ $= 10xm - 6xn - 5ym + 3yn$ **Example**: $(3a + 4b)(2ab - 5a^2)$ $= 3a.2ab - 3a.5a^2 + 4b.2ab - 4b.5a^2$ $= 6a^2b - 15a^3 + 8ab^2 - 20a^2b$ $= 6a^2b - 20a^2b - 15a^3 + 8ab^2$ $= -14a^2b - 15a^3 + 8ab^2$	• Give exercises on product of two binomials.
• find highest common factor of algebraic expressions • factorize binomial	**2.3 Highest common factors** *(10 periods)*	• Assist the students to find the highest common factor of algebraic expression in the following manner. **Example**: Find the highest common factor of 1) $2a^2 x, \ 6a^3y^2x^5$ - The highest common numerical factor is 2 - The highest common power of the factor a is a^2. - The highest common power of the factor x is x but y is not common to each terms $HCF = 2a^2x$	• Ask students to factor out the highest possible factor of a given expression.

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
		2) $ax + ay$, $bx + by$ $ax + ay = a(x + y)$ and $bx + by = b(x + y)$ HCF = $x + y$ 3) Factorize $x^2 - 3x$ The highest common factor of x^2 and $3x$ is x $\Rightarrow x^2 - 3x = x(x - 3)$	

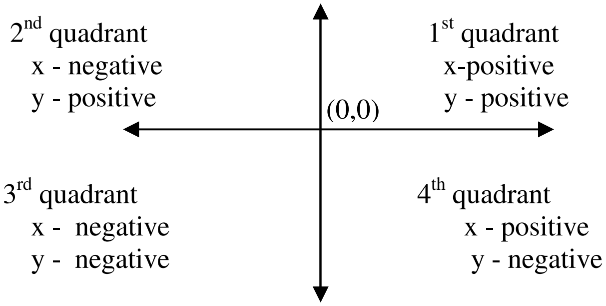
Unit 3: Linear equation and inequalities *(30 periods)*

Unit Outcomes: Students will be able to:

- understand the concept equations and inequalities
- develop their skills on rearranging and solving linear equations and inequalities
- apply the rules of transformation of equations and inequalities for solving problems
- draw a line through the origin whose equation is given.

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
Students will be able to: • solve linear equations involving brackets using equivalent transformation	**3. *Linear equation and inequalities*** **3.1 Further on solutions of linear equations** *(10 periods)* **3.1.1 Solutions of linear equations involving brackets**	• Assist student to revise solving linear equations using equivalent transformation. • Using several examples discuss the following rules to remove brackets. - a + (b + c) = a + b + c - a – (b + c) = a – b – c • Encourage your students to apply the above rules to solve linear equations, you may use examples like 2x – (x + 2) = 1 2x – x –2 = 1 ----- (Removing bracket) x – 2 = 1 x = 3 • Introduce the concept of "ordering and collection of like terms" in simplifying and solving linear equations. You can use examples like: eg. 3(2x + 1) = 2x + 7 6x + 3 = 2x + 7 ------- removing bracket 6x – 2x = 7 – 3 --------- collecting like terms 4x = 4 x = 1	• Give exercises on solving linear equations which involve brackets and check their answers.
• solve linear equations involving fractions	**3.1.2 Solutions of linear equations involving fractions**	• Start the lesson by revising the four fundamental operations on fraction • Motivate students to practise solving linear equations containing fractional coefficient of the variable. You may use examples like: 1. Solve : $\frac{3}{4}x - 2 = \frac{1}{2}$	• Ask your students to solve linear equations involving fractional coefficient of the variable.

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
		$\left(\frac{3}{4}x-2\right)\times 4=\frac{1}{2}\times 4$ - - - (multiply both sides by LCM of the denominators) $3x-8=2$ ---- Simplification $3x = 10$ $x = \frac{10}{3}$ 2. Solve: $\frac{2}{3}x+\frac{1}{2}=\frac{3x-5}{6}$ $\left(\frac{2}{3}x+\frac{1}{2}\right)\times 6 = \left(\frac{3x-5}{6}\right)\times 6$ $4x + 3 = 3x - 5$ $x = -8$	
- solve real life word problems using linear equations	**3.1.3 Solve problems using linear equations**	- Assist your students to go through the following steps in order to solve word problems using linear equations. 1. Understand the problem 2. List all the unknown quantities in the problems using variable (say x, y, z, a, b, etc) 3. Set up an equation which reflects the relationship between the given and the required quantities 4. Solve the equation 5. Check up the result 6. Answer the question in accordance with the problem - Encourage students to practice solving word problems from different fields of mathematics and daily life such as issues of production, taxation, banking and finance, investment, HIV/AIDS. etc.	- Give exercises on real life problem such as production, taxation, HIV/AID, etc.
- use the inequality signs ≥ and ≤ properly, to give solutions	**3.2 Further on Linear Inequalities** *(10 periods)*	- Let students revise solving linear inequalities having variables with positive coefficients - After introducing the symbols "≤" and "≥", assist students to solve inequalaities involving these signs. You may use examples like: "Solve the following inequalities where $x \in W$	
- solve linear		1. $x + 3 > 4$ 2. $x + 3 \geq 4$	- Ask your students

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
inequalities with negative coefficients by applying the rule for transforming linear inequalities		$x > 1$ $x \geq 1$ **Solutions**: 2, 3, 4,… solutions: 1, 2, 3, 4,… • Using several examples, assist students to come to the rule for solving linear inequalities that is multiplying or dividing both sides by the same negative number reverses the inequality sign." you may use examples like: $2 < 3$ OR $9 > 6$ $2 \times (-1) > 3 \times (-1)$ $-2 > -3$ $\frac{9}{-3} < \frac{6}{-3}$ $-3 < -2$ Encourage your students to apply the above rule in solving linear inequalities. You may use examples like: $-2x \geq x + 6$ $-3x \geq 6$ ... subtracting x from both sides $\frac{-3x}{-3} \leq \frac{6}{-3}$ ... dividing both sides by -3 $x \leq -2$	to solve linear inequalities involving negative coefficient of the variable and check their work.
• draw the four quadrants of the Cartesian plane and mark the origin, x - axis and y - axis • plot points on the Cartesian coordinate plane given their coordinates • read the coordinates of any point on the Cartesian coordinate plane.	**3.3 Cartesian coordinate system** *(10 periods)* **3.3.1 The four quadrants of the Cartesian coordinate plane**	• Let students revise how the number ray was extended to the number line. • Assist students to realize that the x - axis and y-axis divide the coordinate plane into four quadrants. • Help students to practise how to plot points in the coordinates plane. • Let students practise how to read the coordinates of points in the coordinate plane • Guide students to describe the sign of coordinates (x, y) in each quadrant. 	• Ask students to determine the coordinates of a given point and also to show/ plot point on the coordinate plane

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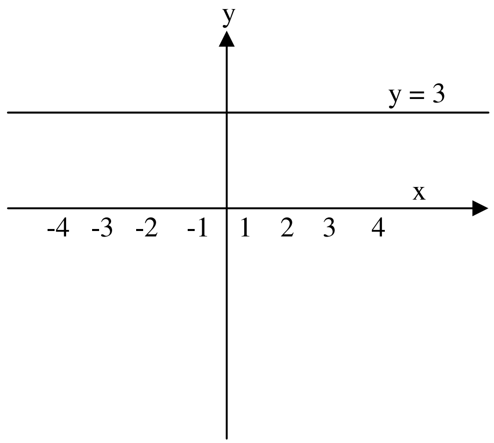
draw straight lines in the coordinate plane whose equations are of the form
$y = a$
$x = b$
$y = mx$

</td>
<td>3.3.2 Coordinates and straight lines</td>
<td>

Start the lesson by drawing table of values for x, and y in which y-is constant and following this let students plot these points and realize that the points lie on a horizontal line.
You may take examples like

<table>
<tr><td>x</td><td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>3</td><td>4</td></tr>
<tr><td>y</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td></tr>
</table>


Encourage the students to refer to this line as $y = 3$ and also to say that $y = 3$ is the equation of the line.
Assist students to come to the conclusion that $y = a$ where $a \in Q$ is an equation for a horizontal line (or a line parallel to the x - axis)
Encourage students to draw lines whose equations are of the form $y = a$ e.g. draw the lines
(a) $y = -1$, (b) $y = 2$

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whose coordinates are given.

Ask students to draw lines whose equations are
$y = a$ (horizontal line)
$x = b$ (vertical line)
$y = mx$ (oblique line through the origin)
where $a, b, m \in Q$ on the coordinate plane and check their work.

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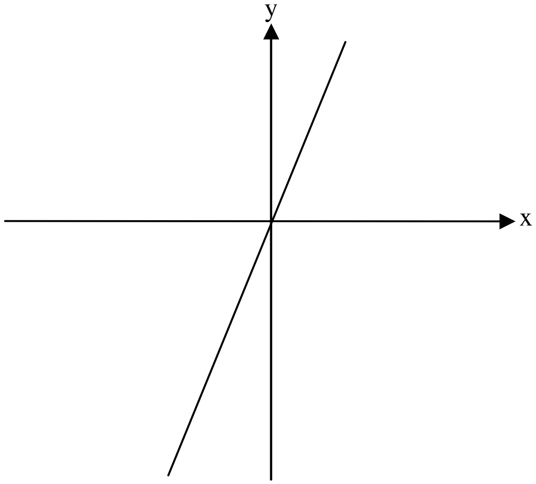
<tr>
<td>• determine the equation that relates the coordinates in a given set of ordered pairs.</td>
<td></td>
<td>• Do the same thing, as suggested above, for vertical line, and assist students to come to the conclusion that $x = b$ where $b \in Q$ is an equation for a vertical line (or a line parallel to the Y - axis)
• Encourage students to draw a straight line whose equation is of the form $x = b$, where $b \in Q$
e.g. Draw the lines whose equations are
a) $x = -3$ b) $x = 5$
• After discussing the direct proportionality of two quantities X and Y assist students to draw a line whose equation is of the form $y = mx$ where $m \in Q$ by discussing the following steps:
1. Make table of values for easy x coordinates
2. Use the equation $y = mx$ (given $m \in Q$) to calculate the y - coordinate
3. Plot the points
4. Draw the lines through these points you may take examples like
Draw the line whose equation is $y = 3x$
<table>
<tr><td>X</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td></tr>
<tr><td>Y</td><td>-6</td><td>-3</td><td>0</td><td>3</td><td>6</td></tr>
</table>


</td>
<td>• After giving set of ordered pairs ask students to write equation that relates them (the ordered pairs are given in such a way that the required equation should be linear)</td>
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Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
• determine the equation of a line that contains points whose coordinates are given.		• Encourage students to come to the conclusion that the line with equation of the form Y = mx - passes through the origin - the number m is called the slope of the line - Let them observe the nature of the lines when m > 0 and m < 0 • Help students to write an equation for a line that contains points whose coordinates are given as list of ordered pairs. You may take examples. Like: Give an equation for the line that contains points (-2, -4), (-1, -2), (0, 0), 1, 2), (2, 4), (3, 6) - They lie on a straight line - The line passes through the origin - In each case the y coordinate is double the x coordinate Therefore we say that Y = 2x is the equation this line	

Unit 4: Similar figures *(25 periods)*

Unit Outcomes: Students will be able to:

- know the concept of similar figures and related terminologies
- understand the condition for triangles being similar.
- apply tests to check whether two given triangles are similar or not.

Competencies	*Content*	*Teaching / Learning activities and Resources*	*Assessment*
Students will be able to: • identify figures that are similar to each other • explain the concept of similar figures	***4. Similar figures*** **4.1 Similar Plane Figures** *(8 periods)* **4.1.1 Illustration and definition of similar figures**	• You may start the lesson by discussing the concept of similar figures using models of figures or objects like: photographs, polygons having the same shape but different in size. • Assist student in groups to draw different pairs of similar figures and to give examples of similar figures from their everyday life.	• Ask students to bring figures/ pictures of any kind to the class that are similar and let them explain how they are similar.
• draw an enlarged figure of a given real object by enlarging factor • draw reduced figure of a given real object by reducing factor • explain facts about two similar triangles	**4.1.2 Scale factors and proportionality**	• Assist students to enlarge or reduce a given figure by using scale factors (enlarging factor./reducing factor) • Help students to come to the conclusion that the scale factor is constant and described by the ratios of corresponding lengths of the figure, so that the ratios are equal which results in the proportionality of the corresponding lengths. • Start the lesson by revising important ideas from are previous topic about scale factors and proportionality of corresponding sides of similar figures (specially by considering triangles)	• Give exercises on drawing of enlarged or reduced figures. • Ask students and let them answer orally what is meant by scale factor, proportional sides of similar figures (specially using triangles)
• Apply the definition of similarity of two triangles to solve related problems.	**4.2 Similar Triangles** *(17 periods)* **4.2.1 Introduction to similar triangles**	• Discuss the similarity of two triangles and motivate the students to define similarity of two triangles.as follows: "Triangles ABC and DEF are similar, if the corresponding sides are proportional and the corresponding angles are congruent: that is, symbolically if $\Delta ABC \sim \Delta DEF$	• Ask students to apply the definition and determine the similarity of two given triangles (to say whether they are similar or not)

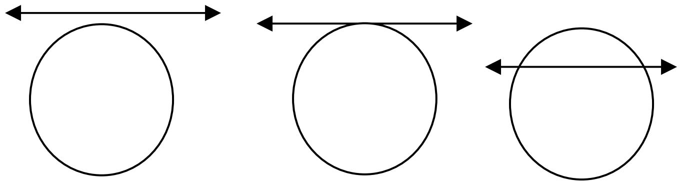
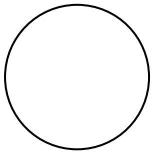
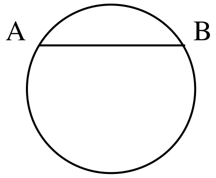
Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
		then $\frac{AB}{DE}=\frac{BC}{EF}=\frac{CA}{FD}=k$ and $\angle A \equiv \angle D$, $\angle B \equiv \angle E$ $\angle E \equiv \angle F$ In doing so emphasis on the correspondence of sides and angles and the use of the symbol " ~ " for similarity should be given. • Encourage your students to apply the definition to solve problems like: "Given $\Delta PQR \sim \Delta MNT$ and if PQ = 2cm QR = 5cm, MN = 4cm then find the length of side NT $\frac{PQ}{MN}=\frac{QR}{NT}$ $\frac{2}{4}=\frac{5}{NT}$ NT = 10 cm	• Check how the students use the symbols (~) for similarity of triangles and (≡) for congruence of the angles correctly.
• apply the SSS, SAS and AA similarity tests for triangles to determine the similarity of two triangles	**4.2.2 Tests for similarity of triangles (SSS, SAS and AA)**	• Assist students to realize that it is not necessary to compare all the corresponding sides and angles of two triangles to check whether they are similar or not. It is enough to compare a certain parts of them, for instance proportionality of three corresponding sides (SSS), proportionality of two corresponding sides and congruence of the included angle (SAS) and congruence of two corresponding angles (AA) As an example, let the students justify one of the tests say SSS. 1. Given triangle with lengths of its three sides given 2. Constant of proportionality (κ) is given • Let students draw a triangle either (enlarged or reduced based on the value of κ) then let them check the corresponding angles of these two triangles are congruent by measuring. • Encourage the students to conclude the similarity of the two triangles based on the definition. • You may use the same method for the remaining two tests (Let the students check every thing by measuring the parts) before applying the tests.	• Give problems on the application of the tests for similarity of triangles.

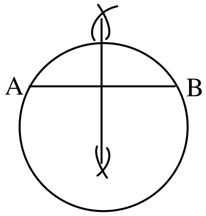
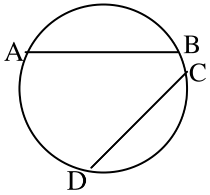
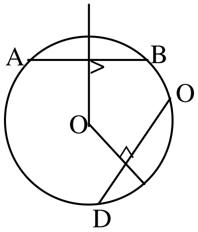
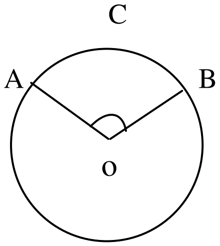
Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
• explain how the perimeters of two similar triangles are related • explain how the areas of two similar triangles are related.	**4.2.3 Perimeter and area of similar triangles**	• Let the students revise how perimeters and areas of triangles are found. • Let students find perimeters and areas of two similar triangles and let them find the ratios of the perimeters and the ratio of the areas. • Assist them to conclude "the ratio of the perimeters of two similar triangles is equal to the ratio of their corresponding sides" and "The ratio of the areas of two similar triangles is equal to the square of the ratio of their corresponding sides."	• Give exercises on finding perimeter and areas of similar triangles.

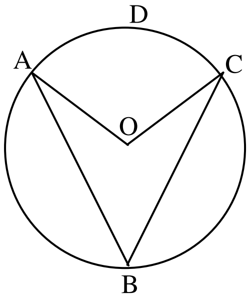
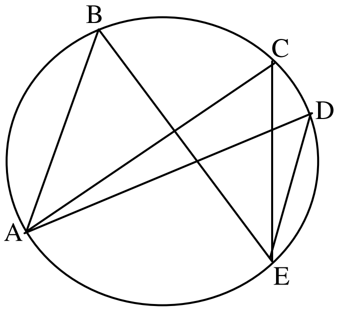
Unit 5: Circles *(20 periods)*

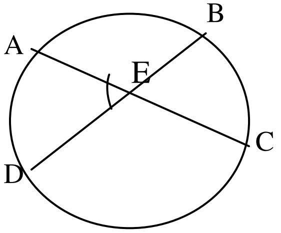
Unit Outcomes: Students will be able to:

- have a better understanding of circles
- realize the relationship between lines and circles
- apply basic facts about central and inscribed angles and angles formed by intersecting chords to compute their measures.

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
Students will be able to: • identify major arc and minor arc • identify sector and segment of a circle concepts • describe the concepts "tangent" and "secant" of a circle.	***5. Circles*** **5.1 Further on circles** *(8 periods)* • parts of a circle.	• Let students revise circle, radius, diameter, chard, and circumference of a circle. • Let the students differentiate minor and major arc by giving examples. • Assist students to demonstrate sector and segment of a circle. • Guide students to show the possibilities for positional relations between a circle and a straight line That is a straight line may intersect a circle at:  No points Only one point Two points • Introduce the concepts "secant" and "tangent" lines	• Ask students to name the major arc, minor arc, tangent and secant line of a given circle where the parts are clearly shown.
• determine the centre of a circle by construction		• Guide the students to determine the centre of a circle, by construction, in the following manner • Draw circle by using coins.  • Draw a chard AB 	• Give problems on finding the centre of a circle by construction.

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
		• Construct the perpendicular bisector of AB  • Draw another cord CD  • Construct the perpendicular bisector of CD • The perpendicular bisectors of AB and CD intersect at O, the centre of the circle. 	
• identify central angles and inscribed angles • calculate the measure of central angle or inscribed angle or the intercepted arc based on the given information.	**5.2 Angles in the circle** *(12 periods)* **5.2.1 Central angle and inscribed angle.**	• After introducing the meaning of central angle and its relation with the arc subtending it, guide students to solve related problems.  $m(\angle AOB) = m(\overset{\frown}{ACB})$ • After introducing the meaning of inscribed angle, encourage	• Give exercises on computing the degree measures of given central angle; inscribed angles and the arc that subtends them.

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
		the students to measure the central angle and the inscribed angle subtended by the same arc and conclude that 1. The measure of the inscribed angle is half of the measure of central angle 2. The measure of the inscribed angle is half of the measure of the arc subtends it.  $m(\angle ABC) = \frac{1}{2} m(\angle AOC)$ $m(\angle ABC) = \frac{1}{2}m(\overset{\frown}{ADC})$ - Let students relate inscribed angles subtended by the same arc. i.e. $m(\angle ABE) = m(\angle ACE) = m(\angle ADE)$ $= \frac{1}{2}m(\overset{\frown}{AXE})$ 	

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
- prove that an angle formed by two chords intersecting inside a circle is equal to half the sum of the intercepted arc by measurement - solve problems related to angle formed by two intersecting chords inside a circle.	**5.2.2 Angles formed by two intersecting chords**	 Given the above circle lead the students 1. To connect D & C using ruler 2. To measure ∠ACD and ∠BDC using protractor 3. Based on step 2 ask them to write the measures of $\overset{\frown}{AD}$ & $\overset{\frown}{BC}$ 4. To measure ∠BEC 5. To relate m (∠BEC) with the sum of m ($\overset{\frown}{AD}$) & m($\overset{\frown}{BC}$) (That is m (∠BEC = ½[m ($\overset{\frown}{AD}$) + m ($\overset{\frown}{BC}$)]	- Ask students to apply the formula given at the end of the lesson and let them check their answer by measuring.
- define "cyclic quadrilateral" - describe property of "cyclic quadrilateral" - prove theorem on the opposite interior angles of a cyclic quadrilateral. - calculate the unknown angle of cyclic quadrilateral	**5.2.3 Cyclic quadrilaterals**	- After introducing the definition of cyclic quadrilateral, guide students to measure the opposite angles of the cyclic quadrilateral & conclude that they are supplementary. - Assist students to prove that the opposite angles of cyclic quadrilateral are supplementary by using the knowledge of inscribed angle. - Guide students to find out the measures of unknown angles of a cyclic quadrilateral	- Give exercises on cyclic quadrilateral and related concepts.

Unit 6: Introduction to probability *(15 periods)*

Unit Outcomes: Students will be able to:

- understand the concept of certain, uncertain and impossible outcomes
- know specific facts about event, sample space and probability of simple events.

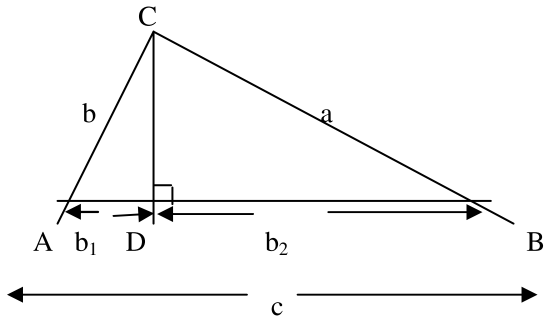
Competencies	*Content*	*Teaching / Learning activities and Resources*	*Assessment*
Students will be able to: • identify certain, and impossible out comes	***6. Introduction to probability*** **6.1 The concept of probability** *(5 periods)* • certain • impossible outcomes	• Assist students to identify certain and impossible out comes by giving different real life examples\ like:. The day after Monday is Tuesday Two lines intersect at three points When water boils it changes to milk The sun rises in the east. • Lead students to associate certain outcome to 1 an impossible out come to 0.	• Ask students to give their own examples.
• identify experiment, event and sample space • determine the probability of simple events • express probability using fractions, decimal and percentage.	**6.2 Probability of simple events** *(10 periods)*	• Help students to understand the concept of probability by explaining uncertainty. Start by using examples like: - If we throw a coin, head or tail can appear. - It may rain tomorrow If a die is thrown anyone of the digits; 1 to 6 may appear on its upper face.	• Ask students question about uncertain out comes of an experiment.
		• All the above statements involve some uncertainty. This uncertainty measured numerically by means of probability. • After defining the words ‘experiments’, ‘event’ and ‘sample space’. Assist students to identify those words mentioned above. For instance when we throw a die six outcomes are possible, they are 1, 2, 3, 4, 5 and 6 we call them sample space and throwing a die is an experiment one of the numbers is an event. • Lead students to derive the formula of probability of an event by giving different examples (i.e. probability of an event $= \frac{\text{No favorable outcomes}}{\text{No of total outcome}}$	• Give exercises on finding probability of simple events.

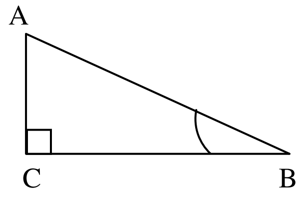
Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
		• Assist students to determine the probabilities of simple events and express in decimal and percentage. eg. What is the probability of choosing the alphabet S from the word" CLASS" Sample space C,L,A,S, S (No. of total out comes is 5) favorable out come is "S" (No. of favorable out comes is 2) probability of choosing S $= \frac{\text{No of favorable outcomes}}{\text{Total No. of outcomes}}$ $= \frac{2}{5} = 0.4 = 40\%$	

Unit 7: Geometry and measurement *(30 periods)*

Unit Outcomes: Students will be able to:

- understand basic concepts about right angled triangles
- apply some important theorems on right angled triangles.
- know basic principles of trigonometric ratios.
- know different types of pyramids and common parts of them.

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
Students will be able to: • apply Euclid's theorem and its converse for solving related problems	***7. Geometry and measurement*** **7.1 Theorems on the right angled triangle** *(12 periods)* **7.1.1 Euclid' Theorem and its converse**	• Start the lesson by considering a right angled triangle ABC and the altitude to the hypotenuse as shown below • The attitude divides ΔABC in to two right angled triangle  • Guide students to compare ΔABC with the other two triangles formed and show the following similarities i) ΔCBD ~ ΔABC... (by AA similarity test) from which $\frac{CB}{AB}=\frac{DB}{CB}\Rightarrow\frac{a}{c}=\frac{b_2}{a}\Rightarrow a^2 = b_2c$ ii) Δ ACD ~ ΔABC - (by AA similarity test) from which $\frac{AC}{AB}=\frac{AD}{AC}\Rightarrow\frac{b}{c}=\frac{b_1}{b}\Rightarrow b^2 = b_1c$ • Following this you can state the Euclid's Theorem and its converse • Encourage students to apply the theorem in exercises like.	• Give exercises on the application of Euclid's Theorem and its converse.

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
		• Ex. ΔABC is a right angled triangle with hypotenuse $\overline{AB}$, and altitude $\overline{CD}$ to $\overline{AB}$. If AD = 4cm, DB = 5cm, find the lengths of $\overline{AC}$ and $\overline{BC}$ • Similarly you can give examples to illustrate the converse of the theorem.	
• apply Pythagoras' Theorem and its converse for solving related problem.	**7.1.2 The Pythagoras' Theorem and its converse**	• Let students revise Euclid's Theorem • Assist students to use the Euclidean relation to derive the Pythagorean relation and then state the theorem. • Encourage students to apply the "Pythagoras" Theorem to solve a real world problem. • After discussing the converse of the Pythagoras' Theorem, Assist students to apply it inorder to solve a real world problem by giving several examples and exercises.	• Ask students questions on the application of Pythagoras' Theorem and its converse
• describe the trigonometric ratios, the sine, cosine and tangent using right angled triangle.	**7.2 Introduction to Trigonometry** *(12 periods)* **7.2.1 The Trigonometric ratios**	• Given a right angled triangle let students name the hypotenuse, the sides opposite and adjacent to a given angle • you may take example like: In the right angled triangle ABC  Name i) The hypotenuse ii) The side opposite to the marked angle iii) The side adjacent to the marked angle • State the three trigonometric ratios using right angled triangle, like the one shown above, as follows $\sin \hat{B} = \frac{\text{length of the side opposite to } \hat{B}}{\text{length of hypotenuse}}$ $\cos \hat{B} = \frac{\text{length of the side adjacent to } \hat{B}}{\text{length of hypotenuse}}$ $\tan \hat{B} = \frac{\text{length of the side opposite to } \hat{B}}{\text{length of the side adjacent to } \hat{B}}$	

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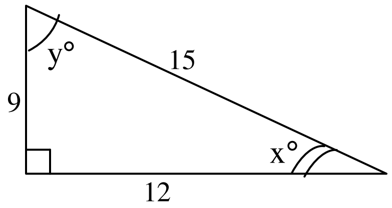
- Let students be familiar with each of these ratios by considering several examples like

Example

Calculate the sin, cos and tan for angles whose measures are given by x^0 and y^0.



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- Give exercise on problems involving description of trigonometric ratios (sine, cosine and tangent) of angles just by giving appropriate length of two or more sides of a right angled triangle. (let them use Pythagoras' Theorem to find a missing length of side)
- Check their work

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- determine the value the trigonometric ratios for 30°, 45° and 60° angles

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7.2.2 The values of sine, cosine and tangent for 30^0, 45^0 and 60^0 angles

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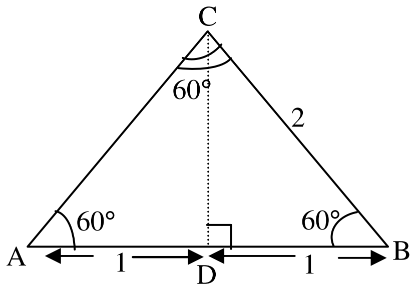
- By using an equilateral triangle of side length 2 units assist students to determine sin 60°, cos 60°, and tan 60°, sin 30°, cos 30° and tan 30°

- You may proceed as follows

a) drop a perpendicular $\overline{CD}$ to side $\overline{AB}$



b) Consider ΔACD
and use Pythagorean relation to find the length
of $\overline{CD}$ which is equal to $\sqrt{3}$ unit

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- Ask students to find the trigonometric ratios for 300, 450 and 600 by using several triangles.
- Check their work

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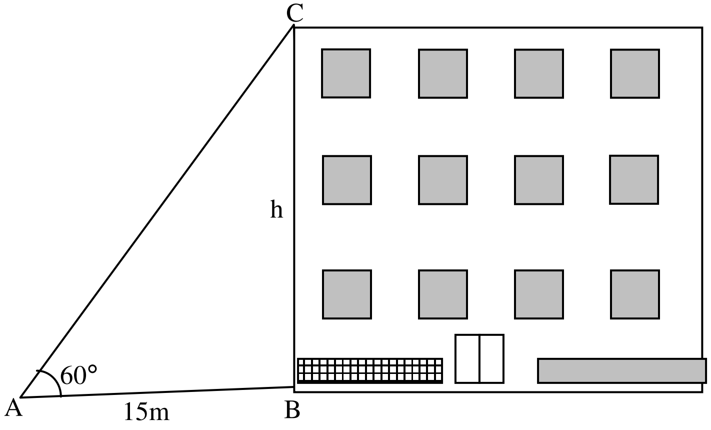
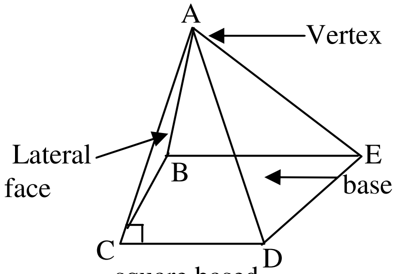
Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
		• Then you can use the values of the trigonometric ratios to find the corresponding values of the angles, for instance. $\cos 30^0 = \frac{\text{length of the side adjacent to } 30^\circ}{\text{length of hypotenuse}}$ $= \frac{CD}{AC}$ $\cos 30^0 = \frac{\sqrt{3}}{2}$ • Similarly you can give the remaining values of 30° and 60° angles shown. • By using an isosceles right-angled triangle with lengths of the legs 1 unit, assist students to determine sin 45°, cos 45° and tan 45° (Note:- The hypotencese measure $\sqrt{2}$ units $\therefore \sin 45^0 = \frac{1}{\sqrt{2}}$ do not rationalize the denominator)	
• apply the trigonometric ratios for 30° and 60° in solving related problems		• You may give several examples from the real world to show the application of the trigonometric ratios for 30° and 60° angles like: eg. Consider the following figure  At a point A, 15m from the foot of a school building, as shown in the fig. above, the angle to the top of the building, C, is measured as 60^0. What is the height of the school building?	

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
		Solution: By considering ΔABC which is right angled, we can use trigonometric ratio. $\tan\ 60^0 = \frac{CB}{AB}$ $\tan\ 60^0 = \frac{h}{15}$ $h = 15 \times \tan 60^0$ $h = 15 \times \sqrt{3}$ $h = 15\sqrt{3}$ m $\therefore$ the height of the school building is $15\sqrt{3}$ m	• Give problems on the application of trigonometric ratios for 30°, 45° and 60° from real life.
• identify parts of a pyramid • orepare models of pyramid • name different types of pyramids based on their bases.	**7.3 Solid Figures** *(6 periods)* **7.3.1 Pyramid**	• Motivate students to mention different objects having the shape of pyramid by showing models of pyramid. • Let students identify vertex, edge and faces of pyramids from the model. • Encourage the students to define a pyramid as follows, A pyramid is a solid defined by a base and a point, called an apex, not on the base. The pyramid takes its name from the name of the base.  square based pyramid • Introduce different types of pyramids like triangular pyramid, pentogorial pyramid and conclude that when the base is a	• Ask students to identify parts of a pyramid and circular cone.

Competencies	***Content***	***Teaching / Learning activities and Resources***	***Assessment***
		circle the pyramid becomes a cone.