The New Senior Secondary Curriculum for Sierra Leone

Subject syllabus for Mathematics for STEAMM
Subject stream: Mathematics and Numeracy

This subject syllabus is based on the National Curriculum Framework for Senior Secondary Education. It was prepared by national curriculum specialists and subject experts.

SSSC
Senior Secondary School Curriculum

Curriculum elements for Mathematics for STEAMM - an applied subject

Rationale for Introduction of STEAMM in the Senior Secondary School Curriculum

The success of the nation as we move through the 21st century continues to depend on ideas and skills. Increasingly, the influence of technology and the availability of information will shape those ideas and skills, resting in large part on how well we address science, technology, engineering, and mathematics in our senior secondary school education. **Science, Technology, Engineering, Agriculture, Mining & Mathematics (STEAMM)** programs provide you with the academic background and training you need to pursue a bachelor's degree, or to immediately launch a career in technology or science fields. STEAMM programmes cover a wide-range of exciting areas such as mathematics and computer science, engineering technology, biotechnology, and life sciences. In addition to integrative experiences connecting the disciplines of STEAMM, students need a strong mathematics foundation to succeed in STEAMM fields and to make sense of STEAMM-related topics in their daily lives.

Topics including robotics, communication, urban transportation, health, space exploration, environmental issues, or disease spread and prevention offer fertile ground for student explorations in STEAMM learning. Students may use mathematics or science to model problems from the aforementioned list as they develop creative approaches and solutions. Mathematics and science play a different role from technology and engineering.

Much can be gained in support of the teaching and learning of mathematics through connecting and integrating science, technology, and engineering with mathematics, both in mathematics classes and in STEAMM activities. Engineering design, for example, offers an approach that nurtures and supports students' development of their problem-solving abilities, a top priority for mathematics teachers. The design process both reinforces and extends how students think about problems and offers tools that can help students creatively expand their thinking about solving problems of all types—the very types of problems and issues that students are likely to encounter in both their personal and professional lives. Mathematics goes beyond serving as a tool for science, engineering, and technology to develop content unique to mathematics and apply content in relevant applications outside of STEAMM fields.

General Learning Outcomes

To develop in all students:

- Mathematics as a language to analyse and communicate information and ideas
- The capacity to use computational and analytic skills for practical use
- Ability to identify mathematical concepts in various engineering fields of study and life science
- The skills to identify mathematics as a tool in the everyday engineering and physical sciences
- An ability to carry out activities and projects in engineering and consequently acquire the values of cooperation, tolerance, and diligence
- An appreciation and enjoyment of mathematics in life situations

Subject Content Outline by Broad Themes & Specific Topics (General Topics)

	SSS 1	SSS 2	SSS 3
Term 1	• Integers • Fractions, Decimals and Percentages • Ratio, Proportion and Rates • Powers and Roots	• Equations and Formulae [change of subject] • Algebraic fractions • Linear inequalities and Quadratic Inequalities. • Relations, Mapping • Sequence and Series	**Statistics** • Data Representation • Data Analysis • Correlation • Variance and standard deviation
Term 2	• Approximation/Estimation • Number Bases • Indices • Surds	• Angles, Line and Triangles • Polygons and Congruency • Lines of Symmetry and rotational symmetry • Pythagoras' Theorem (right angle triangle) • Basic Trigonometry ratio in right angle triangle	**Probability** • Introductory concepts • Permutation and Combination • Binomial Probability Distribution
Term 3	**Sets** • Describe set and the various types. • Apply the algebra of sets. • Solve two and three set problems (including use of Venn diagrams • Algebraic Expressions (simplification) • Algebraic function and graph – Linear, Quadratic, Simultaneous and Cubic Functions	• Mensuration of 2D and 3D shapes • Construction including Loci • Circles	

Subject Content Outline by Broad Themes & Specific Topics (for Engineering Students only)

	SSS 1	SSS 2	SSS 3
Term 1	• Logarithm (laws of log. without logbook) • Inequalities in linear programming • Logical reasoning • Complex numbers	**Calculus** • Differentiation • Applications of differentiation • Integration • Applications of integration	**Vectors** • Vectors and scalars • Properties of vectors (representing vectors, equal vectors, null or zero vector) • The magnitude and direction of a vector • Algebra of vectors • Triangle law of vector addition
Term 2	**Polynomial Functions** • General characteristics • Partial fraction • Exponential function • Logarithmic function • The Binomial Theorem	• Angles of elevation/depression • Bearings • Circle theorems • Area of sector and length of arc • Similarities • Graphs of trigonometric functions • Trigonometric Identities and proofs	**Matrices** • Operations on matrices • Finding the determinant and • inverse of a matrix (limited to 2 x 2 matrices) • Application of matrices (Cramer's rule) to solve simultaneous linear equations in two variables **Linear Transformations** • The concept of linear transformation • Images of points under given linear transformation
Term 3	**Co-ordinate Geometry** • Loci • Straight lines • Circles • Parabolas **Trigonometry** • Trigonometric ratios and rules • Compound angles • Multiple angles	**Statics** • Resultant and resolving forces into components • Equilibrium of coplanar forces • Types of forces (weight, tension, and trust) • Friction and coefficient of friction	

	• Trigonometric functions	**Kinematics of a particle** • Speed, time distance velocity and acceleration. **Dynamics** • moment of inertia of a particle and rigid body • Newton's laws of motion • Motion of two connected particles • Momentum and impulse • Sum of moments • Equilibrium of a lamina under parallel forces	

Subject Content Outline by Broad Themes & Specific Topics (for Physical Sciences Students only)

	SSS 1	SSS 2	SSS 3
Term 1	• Logarithm (laws of log. without logbook) • Logical reasoning	**Calculus** • Differentiation • Applications of Differentiation • Integration • Applications of Integration	**Vectors** • Vectors and scalars • Properties of vectors (representing vectors, equal vectors, null or zero vector) • The magnitude and direction of a vector • Algebra of vectors • Triangle law of vector addition
Term 2	**Polynomial Functions** • General characteristics • Partial fraction • Exponential function	**Statics** • Resultant and resolving forces into components • Equilibrium of coplanar forces • Types of forces (weight, tension, and trust) • Friction and coefficient of friction	**Matrices** • Operations on matrices • Finding the determinant and • inverse of a matrix (limited to 2 x 2 matrices) • Application of matrices (Cramer's rule) to solve simultaneous linear equations in two variables
Term 3	**Polynomial Functions** • Logarithmic function • The Binomial theorem	**Kinematics of a particle** • Speed, time distance velocity and acceleration	

		Dynamics • moment of inertia of a particle and rigid body • Newton's laws of motion • Motion of two connected particles • Momentum and impulse • Sum of moments • Equilibrium of a lamina under parallel forces	

Teaching Syllabus

Topic/Theme/Unit	Expected learning outcomes	Recommended teaching methods	Suggested resources	Assessment of learning outcomes
		YEAR 1/TERM 1		
Integers	Students will be able to: Understand and use integers Understand place value Understand and use directed numbers in practical situations Use the four rules of addition, subtracting, multiplication and division. Use order of operation [BIDMAS]. Use the terms 'odd', 'even', 'prime numbers', 'factors', and multiples' Identify prime factors, common factors, and common multiples	Teacher Modeling and explanations. Examples: Find $\frac{2}{3}$ of 180 $= \frac{2}{3} \times 180$ $= 120$	Teacher Handbook Leaflets, Magazines, Newspapers, Bank reports etc. showing percent, decimals, and fractions	Standard Questions from textbooks and past papers. Probing Questions: Which number up to 100 has the most factors? Which numbers less than 100 has exactly three factors? The sum of four even numbers is a multiple of 4. When is this statement true? When is it false? Can a Prime Number be multiple of 4? Why? Multiplication makes numbers higher. When is this statement True? When is it false?

Fractions, Decimals and Percentages	Students will be able to: Convert between fractions, decimals, and percentages Work using equivalent fractions Add, subtract, multiply and divide fractions and mixed numbers Order fractions and calculate fraction of any given amount Express a given number as a fraction of another number Use decimal notation and understand Place Value Order decimals Recognise terminating and recurring decimals. Know that a terminating decimal is a fraction Convert recurring decimals to fractions Explain that 'percentage' means 'number of parts out of 100'.	Teacher Modelling: $0.65 = \frac{65}{100} = \frac{13}{20}$ Change $0.\dot{3}$ to a fraction in its simplest form. Let Fraction = F F=0.3333 [multiply by 10] $\underline{10F = 3.3333}$ 9F = 3 $F = \frac{3}{9} = \frac{1}{3}$ Convert $0.\dot{1}\dot{3}$ to a fraction Let Fraction = F; F = 0.131313 Multiply by 100 100 F = 13.131313 [Subtract] 99F = 13 $F = \frac{13}{99}$ Convert $0.2\dot{3}$ to a fraction Let F = 0.23333 Multiply by 10 10F = 2.3333 Multiply the equation above by 10 $\underline{=100F = 23.333}$ Subtract first equation from the second 90F = 21 $F = \frac{21}{90}$ $F = \frac{7}{30}$		Explain to me which fractions or percentages you can easily work out in your head. To calculate 10% of a quantity, you can divide the quantity by 10. So to calculate 20%, you must divide by 20. True or False? Explain. What do you look for first when you are ordering numbers with decimals? Give me a number between 0.13 and 0.17. Which of the two numbers is it closer to? . Give me a fraction between ⅓ and ½. Explain how you did it. How do you go about finding the multiplier to calculate an original amount after percentage increase or decrease? Can you find the multiplier if it was a fractional increase or decrease? Explain.

	Express a number as a percentage of another number Express a percentage as a fraction and as a decimal Calculate percentage increase and decrease Calculate percentage profit and percentage loss Use multiplier to calculate reverse percentage [or finding the original] Distinguish between simple and compound interest and calculate compound interest Understand and calculate depreciation Understand and do calculations involving hire purchase and percentage error Calculate repeated percentage changes.	Multiplier Explain to students that when a quantity is increased by 20% for example the new quantity is now 120% of the original [100+20] 120% means $\frac{120}{100} = 1.2$ This is called the multiplier. when a quantity is increased by 15%, the new quantity becomes 115% [100+15] of the original quantity. 115% means $\frac{115}{100} = 1.15$. This is called the multiplier. . Similarly, when quantity is reduced by 150%, The new quantity is 85% [100 – 15] of the original amount. 85% This means $\frac{85}{100} = 0.85$. This is the Multiplier. Example: In a sale, prices were reduced by 30%. The sale price of a shoe was Le140,000.00. Calculate the original price. Solution: 30% reduction means 100 – 30 which is 70% ie Multiplier is 0.7 Let original price = N N x 0.7 = 140 000 N = $\frac{140\ 000}{0.7}$ N = Le200,000.00		Given a multiplier how can you tell whether this would result in an increase or a decease? Can you do fraction division without changing the division to multiplication and inverting the fraction? Explain. How do you know that a fraction will produce recurring or terminating decimal? Which of the following Statement is true or false? All terminating decimals can be written as fractions. All recurring decimals can be written as fractions. All numbers can be written as a fraction. Give students a set of problems involving repeated percentage changes and a set of calculations. Ask pupils to match the problems to the calculations.

		Example Fatima invests Le300,000.00 in a bank at 4% Compound Interest. Calculate the total amount after a period of 3 years. <u>Solution</u> 4% Interest means multiplier is [100 +4] 104% which is equal to 1.04. Compound Interest means this is applied each year. So 1^{st} year = 3000000 x 1.04 2^{nd} year =[3000000x1.04]x1.04 3^{rd} "=3000000x1.04x1.04]x1.04 This is neatly written as $300,000 \times 1.04^3$ = Le 337,459.20		A store gives 20% discount but you must also pay a 15% Tax [G.S.T]. What would you prefer to be calculated first? The discount or the tax?
Ratio, Proportion and Rate	Students will be able to: Use ratio notation including reduction to its simplest form and its links to fraction notation. Divide any amount in any given ratio or ratios. Use the process of proportionality to calculate unknown quantities. Carry out calculations on Direct inverse, Partial and Joint variations.	Teacher Modeling: Incorporate real life examples. Example: it will take a certain number of workers to lay a certain number of building blocks. How many men will it take to lay a certain number of blocks?	Teacher Handbook	Students answer standard questions from Textbooks and Examination board past papers.

	Calculate rates of work, foreign exchange, density [including population density, speed, distance, and time.			
Powers and Roots	Students will be able to: Identify square and cube numbers. Calculate square, square roots, cube, and cube roots. Find highest common factor [HCF] and Lowest Common Factor [LCF]	Teacher Modelling	Teacher Handbook Calculators	Standard questions on Powers and roots. Probing Questions: Are the following statements Always, Sometimes or Never true? -Cubing a number makes it bigger. -The square of any number is always positive. -You can find the square root of any number. -You can find the cube root of any number. Three security guards each flash their lights at intervals of 5 minutes, 10 minutes and 15 minutes respectively. If they all flash their light at 9.00p.m., when next will they all flash their lights at the same time?

YEAR 1/TERM 2				
Approximation and Estimation	Students will be able to: Round numbers to a given number of decimal places or significant figures Identify and solve problems using upper and lower bounds where values are given to a degree of accuracy	Teacher modelling	Teacher handbook	Standard questions on rounding to decimal places and significant figures. Questions on upper and lower bounds.
Standard Form	Students will be able to: Convert ordinary number to standard form. Convert standard form to ordinary number. Solve problems involving standard form.	Teacher Modelling Writing ordinary numbers in standard form Writing numbers in standard form as ordinary number	Teacher Handbook	Standard questions on standard form from past questions Probing questions: What are the key conventions when using standard form? How do you go about expressing a very small number in standard form
Number Bases	Students will be able to: Understand concept of number bases in counting systems Convert numbers from one base to another Perform basic operations on number bases	Teacher Modelling Explain the concept of number bases and the idea of counting in groups.	Teacher Handbook	Students answer standard questions on number bases. Probing Questions: What will happen to the digits if a number in base two when it is: [a] multiplied by two [b] divided by two

	Solving equations involving number bases			How many different symbols exist in a base five system? What are they? The Limbas and Sherbro people count in base five. Can you investigate what base is counting done in your language and any two other languages?
Indices	Students will be able to: Write an integer as a product of its prime factors in index form. Use index laws to simplify and evaluate numerical expressions involving integer fractional and negative powers. Solve indicial equations	Teacher modelling: Expressing a number as a product of its prime factors in index form. The rules of Indices Solving equations involving indices	Teacher Handbook	Students answer standard questions from past examination board papers. Probing Questions: What is the value of c in the question? 48 x 56 = 3 x 7 x 2^c What does the index of ½ represent?
Surds	Students will be able to: Perform the four operations on surds $(+, -, \times \ \& \ \div)$ Rationalise the denominator (including binomial denominators)	Review the concept of perfect squares Discuss with the students how a multiple number is simplify into two factors Eg. $\sqrt{500}=\sqrt{100 \times 5} = \sqrt{100} \times \sqrt{5}$ $= 10\sqrt{5}$ Solve problems with students involving addition, subtraction, multiplication and division of surds. Demonstrate to the students how to rationalise denominators	Table of perfect square roots. $\sqrt{4}$ = 2 $\sqrt{9}$ = 3 $\sqrt{16}$ = 4 $\sqrt{25}$ = 5 Etc.	Class exercises E.g. Simplify $\sqrt{225}$, $\sqrt{243}$ Etc. Evaluate and leave your answer in $a\sqrt{b}$ $a).\sqrt{50} + \sqrt{18}$ b). $\sqrt{847} - \sqrt{175}$ Rationalize the denominator

YEAR 1/TERM 3				
Sets Theory	Students will be able to: Explain what a set is and describe the types of sets Use the language and notations of set. Interpret, draw and use Venn diagrams to solve problems.	Teacher Modelling Introduce the topic of set Talk about language and notations of set e.g. members, cardinality, intersection, union, compliments. Talk about types e.g. universal, unit set, null set, sub set etc. Interpret and draw Venn diagrams.	Teacher Handbook Diagram of various set type on vanguard Illustrated Venn diagram on vanguard	Answer standard questions on set theory from Examination Board past papers. Ask student short answer questions E.g., Name any 3 types of set. Write two sets and ask students to illustrate union, intersect and complement of set. Write a three sets word problem on the board and asked the students to calculate i). One only ii) Both iii)All the three
Algebraic Expressions	Students will be able to: [i] collect like terms [ii] Expand single brackets. [iii] Expand double brackets [iv] Factorise algebraic expressions by: • Linear factorization • Difference of 2 squares • Quadratic factorisation	Teacher Modelling When modelling, explain to students that factorisation can be viewed as a reverse process of expansion. When factorizing simple quadratic expressions, get children to work in groups of 4 or 5. -recall the process of expanding double brackets and simplifying. Example:	Teacher Handbook	Students answer standard questions especially those from past Exam Board Questions. Probing Questions What is a quadratic expression? How would you recognise a quadratic expression?

	• Group factorisation • Solve word problems in context.	(x-3) (x+4) x(x+4)-3(x+4) x^2 +4x – 3x – 12 x^2 + x – 12 Give students several quadratic expressions with coefficient of x^2 = 1 and ask them to work backwards and find the two brackets that were multiplied together to produce the quadratic expression given. When students think they have found their two brackets get them to expand their brackets and simplify to self-check if they are correct. Students need support with the manipulation of signs. Ask pupils to clearly write down their rules and how they got their answers. Ask pupils to do presentation to the class. Clarify misunderstandings and misconceptions.		Why is (x + 5)(2x – 3) a quadratic expression? What is the difference between a quadratic expression and a cubic expression? When (x + 6)(x + 3)(x – 1) is expanded and simplified what expression will you get? Give students examples of multiplying out a bracket with errors. Ask them to identify and talk through the errors and how they should be corrected. Example: 4(b + 2) = 4b +2 3(p – 4) = 3p – 7 -2((5 – b) = 10 – 2b 12 –(n – 3) = 9 – n
Linear Functions	Students will be able to: Identify linear function represented by a straight-line graph Sketch graphs of linear	Discuss linear function as a graph $f(x) = ax + b$ is a line with slope $m = a$ and y- intercept at $(0, b)$. Teacher Use the graph board, Blackboard ruler, colored chalks and allow students to	Graph board Graph paper Blackboard ruler Foot rule Markers Colored chalks Pencils	Plot the points and find the slope of the lie that passes through the pair of points i). $(-3, -)$ and $(1,6)$ ii). $(2,4)$ and $(4, -4)$

	equations Derive equations of linear equations using a) slope-intercept b) slope point c) two points Find equations of parallel and perpendicular lines to a given line Solve simultaneous linear equations graphically or algebraically	work on graph paper to demonstrate how to sketch linear graph Help the students derive equations of linear equations using a) slope-intercept $m = \frac{y_2 - y_1}{x_2 - x_1}$ b) point - slope $y - y_1 = m(x - x_1)$ c) two points $D(x, y)$ and $R(x, y)$ Parallel line $\leftrightarrow m_1 = m_2$ Perpendicular line $m_1 m_2 = -1$ Where $m_1 m_2$ are gradients of the two lines? Teacher Use the graph board, Blackboard ruler, Colored chalks and allow students to work on graph paper to demonstrate how to sketch simultaneous linear equations graphically and algebraically (including methods of elimination and substitution		Use the point on the line and the slope of the line to determine the general equation of the line. 1. Point (2,1) and slope m =1 2. Point (-5,4) and slope m =2 Determine whether the lines L_1 and L_2 are parallel or perpendicular i). L_1(0,-1),(5,9) $L_2(0,3), (4,1)$ .L_1(3,6),(-6,0) $L_2(0,-1), (5, \frac{7}{3})$ Solve the following pair of simultaneous linear equations: $2x + 3y = 8$ $3x + 2y = 7$ Using elimination, substitution and graphical methods.
Quadratic functions	Students will be able to: Recognise quadratic functions represented by a parabola Sketch graphs of quadratic functions using turning points, intercepts and axis of symmetry Determine the nature of the roots of a quadratic equation Use the	Teacher to define quadratic function. Let a, b, and c be real numbers with $a \neq 0$. The function $f(x) = ax^2 + bx + c$ Use the graph board, blackboard ruler to illustrate quadratic graph turning points, intercepts and axis of symmetry. Solve problem on quadratic equation by a) Graphical method b) Factorizing method c) Completing the square d) Quadratic formula	• Graph board • Graph paper • Blackboard ruler • Foot rule • Markers • Colored chalks Pencils	Solve the quadratic equation by completing the square I. $x^2 + 4x + 1 = 0$ Solve the quadratic equation by formula method $-4x^2 + x + 3 = 0$.

	discriminant Solve quadratic equations by a) Graphical method b) Factorizing method c) Completing the square d) Quadratic formula • Derive quadratic equations given sufficient information • Solve simultaneous equations for one linear, one quadratic • Extend concepts to sketching and solving quadratic inequalities	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ Demonstrate the Roots of quadratic equations – equal roots ($b^2 - 4ac = 0$), real and unequal roots ($b^2 – 4ac > 0$), imaginary roots ($b^2 – 4ac < 0$); sum and product of roots of a quadratic equation e.g. if the roots of the equation $3x^2 + 5x + 2 = 0$ are α and β, form the equation whose roots are $\frac{1}{\alpha}$ and $\frac{1}{\beta}$. Solving quadratic inequalities		Solve the quadratic equation by graphical method. i. $-4x^2 + x + 3 = 0$
Cubic functions	Students will be able to: Recognise cubic functions as functions of degree 3 Draw graphs of cubic functions for a given range Factorise and solve cubic equations	Discuss cubic functions as functions of degree 3 e.g. f: $x \rightarrow ax^3 + bx^2 + cx + d$. Teacher should support students to Draw graphs of cubic functions for a given range. Explain how to Factorize cubic expressions and solution of cubic equations. Factorization of $a^3 \pm b^3$		**Cubic Function** Determine the roots of the cubic equation $2x^3 + 3x^2 – 11x – 6 = 0$ Find the roots of the cubic equation $x^3 - 6x^2 + 11x – 6 = 0$ Solve the cubic equation $x^3 – 23x^2 + 142x – 120$ Find the roots of $x^3 + 5x^2 + 2x – 8 = 0$ graphically.

YEAR 2/TERM 1				
Equations and Formulae [change of subject]	Students will be able to: Rearrange a formula or equation to change the subject; including cases where the subject appears more than once or has powers. To evaluate a letter by substituting into a formula given the values of other letters.	Teacher modelling on rearranging formula. Explain that in a formula, a letter usually stands alone on one side of the equal to sign whilst the other letters and/or numbers are all on the opposite side. The letter that stands alone is called the subject of the equation. Example Make r the subject of $V=\underline{4}\ \pi\ r^3$ Make L the subject of $T = 2\pi\ \sqrt{\underline{L/G}}$ When modelling, explain to students that the process of changing the subject of a formula is similar to the process of solving equations. This is because when solving an equation in x for example, we end up with x on its own on one side of the equal to sign. Model substitution into a formula.	Teacher Handbook	Standard Questions on change of subject. Probing questions: What do you mean by the subject of a formula? How do you decide on the steps you need to take to rearrange a formula? What are the important conventions? What strategies would you use to rearrange a formula where the required subject occurs twice? What are the similarities and differences between rearranging a formula and solving an equation? What precautions would you take when substituting negative values into a formula?
Algebraic fractions	Students will be able to: Simplify algebraic fractions with monomial and binomial denominations.	Teacher Modelling Example: Simplify [i] ⅟a + ⅟b [ii] ⅟x+2 + 3/x-2	Teacher Handbook	Students answer standard questions on algebraic fractions.

		[iii] $\frac{3x^2 + 9x}{X^2 + 4x + 3}$ [iv] $\frac{x^2 + 3x - 4}{X^2 + x - 2}$		
Linear inequalities and Quadratic Inequalities	Students will be able to: Explain what an inequality is and the signs associated with it. Solve problems on linear inequalities and represent on a number line. Draw and interpret graphs of inequalities and represent areas defined by inequalities by shading. Solve simple quadratic inequalities in one unknown and represent the solution set on a number line. E.g. $x^2 \leq 36$ $4x^2 > 25$ $X^2 + 3x + 2 > 0$ Apply inequalities to simple real life situations [Linear programming]	Teacher Modelling Explain to students that the techniques used in solving equations is the same used in solving Inequalities. Model solving an equation like 3x+2=10 alongside and Inequality like 3x+2 >10. Model representation on a Number Line. When shading areas to define inequalities, remind students to shade off the wrong area of each inequality as they are drawn. Model the use of linear programming to solve real life situations like profit maximisation. Example: A group of students hired the school hall that holds 200 people for their end of year concert. They priced their tickets at $2 or $3 each. They agreed they will need to raise $450 from this concert. They also decided that the number of $3 tickets must not be greater than twice the number of $2 tickets. If they sell x tickets at $2 each and y tickets at $3 each, calculate the maximum profit they could make.	Teacher Handbook Graph paper	Students to answer standard questions on Linear Inequality and Linear Programming. Probing Questions: How did you go about finding the solution set for this Inequality? What are the important conventions when representing the solution set on a Number Line? Why does the inequality sign change when you multiply or divide the inequality by a negative number? How many Inequalities do you need to describe a closed region? Convince me. How do you check if a point lies: -inside the region -outside the region -on the boundary of the region.

Relations, Mapping	Students will be able to: Distinguish between the various types of relations Use function notation to describe simple functions [Mappings] Find the range of a function for a given domain. Find the inverse of a given function. Work with Composite functions	Teacher Modelling and explanations. Discuss relations and explain the relations. • Many-to-many • One-to-many • Many-to-one • One-to-one Relate functions to a number machine with input and output. Input→ multiply by 2→add 5→output For any input the instruction is to multiply that input by 2 first and then add 5. If the Input is x, then the output is 2x+5. This number machine is an example of a function, which is a process that takes one number and turns it into [maps into] another number. We say x is mapped to 2x+5. Functions are often given names such as f,g,h, and so on. The rule for the above function is written as: F(x)=2x+5 or F:x→2x+5 using arrows instead. Explain: • Domain and Co-domain • Inverse function • Composite functions	Teacher Handbook	Students to answer standard questions on functions
Sequence and Series	Students will be able to: Distinguish between a sequence and a series and be familiar with the	Teacher Modelling Explain sequence Explain series	Teacher Handbook Multilink Cubes Matchsticks Counters	Students answer standard Question on A.P and G.P including those from past Exam Board question papers.

	language and symbols of sequences. Be familiar with the sequence of odd number, even numbers, square numbers, cube numbers, Triangular numbers, Prime numbers, and continue a sequence with more terms. Recognise an Arithmetic Program and find its general term and sum of terms. Recognise a geometric progression and find its general term and sum of terms.	Explain the terminologies e.g. terms, difference, last term, number of terms, sum of term, first term, common ratio, sum of terms and their respective symbols. Explain how to use the common difference [d] and first term [a] in an arithmetic sequence. Eg given 2^{nd} term is 7 and 5^{th} term is 19, find a and d. Model the use of nth term = a+(n-1)d Model the use of Sum of terms $= \frac{N}{2}(a+L)$ where L is the last term. $=\frac{N}{2}(2a+(N-1)d)$ Model use of general term and sum of G.P Get pupils in groups and ask them to produce their own sequences from everyday objects. Example: Matchsticks, multilink cubes, Matchboxes, counters and present a formula for the general term of their sequence.	Matchboxes	Probing Questions: [i] can you find a quick way of adding up the numbers from 1 to 10 to give 55? [without calculator] [ii] what about adding up the numbers from 1 to 20. [iii] what about adding the numbers from 1 to 100. [iv] what do you look for to decide whether a sequence is Linear or Quadratic?
		YEAR 2/TERM 2		
Angles, Line and Triangles	Students will be able to: Distinguish between acute obtuse reflex Draw and measure angles and right angles.	Teacher Modelling Angles around a point Vertically opposite angles Alternate angles Corresponding angles	Teacher Handbook Protractors	Students answer standard questions on angles and parallel lines. Students to draw their angles and measure using protractor as

	Use angles related to intersecting lines and parallel lines. • understand the exterior angle of a triangle property and the sum angle of a triangle property. • understand the terms 'Isosceles', equilateral , 'Scalene' and right-angled triangles' and their related properties.	Interior [allied] angles Teacher to identify local resources as examples of the different triangles. Students to physically draw several angles and measure using protractor.		students to also draw given angles.
Polygons and Congruency	Students will be able to: Recognise and give the names of polygons. Know angle sum of a quadrilateral, name all quadrilaterals and state their properties. Know what a regular polygon is and calculate interior and exterior angles of regular polygons. Derive the sum of angels of a polygon, of n sides as (N-2)180. Use formula Exterior angle = $\frac{360}{\text{No of sides}}$	Teacher Modelling When modelling sum of angles of a polygon, use an investigative approach. Students draw out triangles in quadrilaterals, Pentagon, hexagon etc and fill a table similar to the one below. Students to look for connection between the Number of sides and the possible number of triangles in the shape and if 1 triangle has 180^0, then for any number of triangles, find the sum by multiplying by 180^0	Teacher Handbook	Students to answer standard questions. Probing Questions: Describe a rectangle precisely in words so that someone else can draw it. What mathematical words are important when describing a rectangle? what properties do you need to be sure a triangle is Isosceles, or equilateral or scalene? which of the following statements are true? -any two right angle triangles will be similar.

	Know the meaning of congruent shapes			-All circles are similar -if you enlarge a shape you get two similar shapes. Which quadrilateral has only 1 line of symmetry? True or false? Explain -A square is a rectangle but a rectangle is not a square. -some trapezia may not have a line of symmetry. -A rhombus is a parallelogram but a parallelogram is not a rhombus. Which quadrilateral can have 3 acute angles? Which triangle is a regular polygon? Which Quadrilateral is a regular polygon?
Lines of Symmetry and rotational symmetry	Students will be able to: Identify lines of symmetry and the order of rotational symmetry of a 2D figure	Teacher Modelling: Rotational symmetry is when a shape can rotate and fits into itself as it is rotated. The number of times it will fit into itself before reaching its original position is called the order.	Car wheel covers Car 'badges'	Students to answer standard Questions

Pythagoras' Theorem (right angle triangle)	Students will be able to: Calculate in right angled triangles using Pythagoras Use the trigonometric ratios to calculate lengths and angles in right angle triangles. Use sine and cosine rules to calculate lengths, distances and angles in non-right-angle triangles.	Teacher Modelling Recap Pythagoras theorem. Do initial work on labelling of sides of right-angle triangle with given angle. Students must be able to identify opposite, adjacent and hypotenuse before moving on to main task.	Teacher Handbook	Standard questions on Pythagoras and Trigonometry. Probing Questions: How do you decide whether a problem requires use of a trigonometric relationship [sine, cosine or tangent] or Pythagoras theorem to solve it? Why is it important to understand similar triangles when using trigonometric relationships? ABCD is a square and X is a midpoint on AB. Calculate angle AXD
Basic Trigonometry ratio in right angle triangle	Students will be able to: calculate the values of trigonometric ratios of 30^0, 45^0 and 60^0 and to do calculations involving trigonometric ratios	Teacher Modelling Use the Unit square to derive the values of Sin $45^{0,}$ Cos $45^0$and Tan 45^0 Use the standard Equilateral Triangle of length 2 units to derive the values of Sin $30^{0,}$ Cos 30^0, Tan 30^0, Sin 60^0, Cos 60^0, Tan 60^0	Teacher Handbook	Standard Questions on trigonometric ratios including from Exam board past papers. Fi sinx = 3/5 What is Cosx? What is tanx?

YEAR 2/TERM 3				
Mensuration of 2D shapes	Students will be able to: Convert measurements within the metric system including Linear and area units. Find area and triangles and rectangles including compound shapes. Find area of parallelograms and trapezia. Distinguish between Metric and Imperial units	Teacher Modelling Converting cm^2 to m^2 and vice versa. Opportunities for practical activities to be exploited. Example: students expected to measure and calculate areas and perimeter of accessible areas in the school environment eg doors, tables, surfaces, school playground. Identification of shapes from the local environment. E.g. paper currencies are rectangles. Clarify the misconception of base and height of a triangle by explanation and diagrams.	Teacher Handbook Measuring Instruments Trundle wheel Measuring tapes	Students answer standard questions. Discussing with students during practical activities. Probing Questions: Yeabu said there can only be one triangle with an area of $12cm^2$ Tommy disagrees. Explain why Tommy is right. The base and height of a triangle are always at 90^0 to each other. State whether this statement is Always, sometimes or never true. Is the following statement always, sometimes, or never true? If a rectangle has a larger perimeter than another one, then it will also have a larger area.
Mensuration of 3D shapes	Students will be able to: Recognize and name 3D solids	Teacher Modelling	Teacher Handbook 3D sets of models including solids	Standard questions on 3D shapes and volumes.

	Understand the terms 'face' 'edge'' and 'vertex' in the context of 3D solids. Distinguish between Prism and non-Prisms [i.e. Prisms have a uniform cross-sectional area all along its length] Find the volume of Prisms and non-Prisms like Cone, Pyramid and compound shapes. Understand what total surface area is and calculate total surface area of 3D shapes, Convert between units of volume within the metric system i.e. cm^3 to $m^3$and vice versa. I Litre = $1000cm^3$	3D shapes to be displayed to include cube, cuboid. Prisms, pyramid, cylinder, sphere, hemisphere, cone, frustum.	collected from the local environment.	
Construction including Loci	Students will be able to: construct: Angles bisectors and bisectors of line segment. A perpendicular from a point to a line. A perpendicular from a point on a line.	Teacher Modelling -Model the whole of construction to include angles 75^0, 105^0, and 135^0 Teacher Modelling Make connection between Loci and Construction. Example: A perpendicular bisector of a line AB is the Loci of points equivalent from A and B	Compasses and rulers. Compass Pencils	Students to answer standard questions on construction including from past Exam Board Questions. Probing Questions: How does knowledge of properties of a rhombus help with simple constructions like bisecting an angle?

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<tr>
<td></td>
<td>A line parallel to another line.

Angles 90^0,60^0, $45^0$and 30^0

Triangles and quadrilateral with enough information

Students to understand the concept of Loci and construct Loci of:

[i] points at a given distance from a given point [a circle]
[ii] Points equidistant from 2 given points [bisector of a line]
[iii] Points equidistant from 2 given lines [Angle bisector]
[iv] Points at a given distance from a given line [Line parallel to another line]
[v] Apply Loci to real life situations.</td>
<td></td>
<td></td>
<td>For which constructions is it important to keep the same compass arc? Why?

The following are given as lengths of triangles which ones can never be triangles?
Explain:
[i] 5cm, 6cm, 8cm
[ii]8cm, 4cm, 13cm
[iii] 9cm, 6cm, 15cm
[iv] 7cm, 4cm, 5cm
[v] 12cm, 8cm, 3cm

Students to answer standard questions on Loci</td>
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<tr>
<td>Circles</td>
<td>Students will be able to:

Recognise parts of a circle. E.g. centre, radius, diameter, circumference, tangent, arc, sector, segment, chord segment,

Students will be able to: calculate Area and Circumference of a circle, including Compound shapes and semi circles.</td>
<td>Teacher modelling

-calculating area and circumference of circles, including Compound Shapes.
-investigative approach to obtain value for Pi.
-get students to measure the circumference and diameter of various round object or circles of different sizes and record results in table.

<table>
<tr><td>Circumference</td><td>Diameter</td><td>Circumference ÷Diameter</td></tr>
<tr><td></td><td></td><td></td></tr>
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</td>
<td>Teacher Handbook
Various round objects, circles.
Measuring instruments e.g. Calipers, ruler, tape measures
Strings, thread</td>
<td>Students answer standard questions on Circles.

Probing Questions:

State one similarity and difference between a chord and a diameter.</td>
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	Students will be able to: investigate the relationship between the Circumference and diameter for various circles and obtain a Value for 'pi'.	Students to divide the circumference by the diameter. What conclusions can they draw. This value is an estimate of the Constant Pi.		
YEAR 3/TERM 1				
Statistics --Data Representation	Students will be able to: Recognise, construct and interpret pictograms, bar charts, [vertical, horizontal and composite] and pie chart. Use ICT [Spreadsheet] to design charts.	Display various charts as seen in real life situations E.g. newspapers [Awoko business], adverts, magazines, websites. Get students to identify charts and discuss amongst themselves before asking them to share with the whole class their understanding of the charts and what information they can draw.	Newspapers, reports, advertisement, magazines. compasses and rulers secondary data	Students are given secondary data and asked to construct appropriate charts. **Asking probing questions** -How did you decide on how to organize your table of results? -What made your chart easy or difficult to construct? -Which chart[s] is mainly used to represent categorical data?
Statistics - Grouping Data	Students will be able to: Construct grouped frequency table with equal class intervals and identify the modal class interval from grouped frequency table. Construct and interpret frequency diagram from group discrete data.	Display the various charts as seen from real life examples from newspapers, adverts, textbooks and magazines. Pupils given opportunities to talk about charts /diagrams/graphs and their understanding of the charts. Model the construction of each chart. Ensure pupils understand scaling of axis.	Graph paper Plain paper Newspapers Magazines Coloured Pencils	Pupils answer standard questions on constructing tables and drawing frequency diagrams, Histograms, Frequency Polygons. Probing questions: What difference[s] can you see between a frequency diagram and a histogram?

	Construct and interpret Histograms from grouped continuous data Construct frequency polygons and compare two or more sets of data using super imposed frequency polygons.	Pupils construct their own diagrams. Pupils' work put on display.		If you were to collect data to draw a histogram, what type of data would you collect? Give examples of such data. What is important when choosing the scale of your graphs.
Statistical Measures -Estimating Mean from grouped data, -Identify modal class for grouped data and the class interval that contains the median.	Students will be able to: Calculate an estimate of the Mean from grouped data. Identify the Modal class interval and the class interval where in the median of the data lies.	Review prior knowledge from SSSI on Mean, Median, Mode and Range from a list. Also review Mean from Frequency Table. Review – Tallying of data for Frequency table. Use of the inequality sign when grouping data. Teacher models how to estimate Mean for grouped data, and show how this is almost similar to calculating Mean from a Frequency table. The concept of 'mid-point' should be carefully modelled and 'teased-out' from students by questioning and finally concluding that the mid-point is merely representing all the numbers within a class interval. Hence the Mean becomes only an estimate. Explain to students that by grouping the data, we have lost the frequency of the individual members of the class – interval. We only have the total frequency of the class interval. Teacher Models how to identify the Modal class interval and the interval where the Median lies.		Students answer standard questions. Probing Questions: Why is it only possible to estimate the Mean from grouped data? Why is the Mid-Point of the class interval used to calculate an estimated mean? Why not the end of the class interval? Write an essay on the steps you will take to estimate the Mean from grouped data. How could you possibly use a grouped frequency table to estimate the range and the median.

Tabulation and Representation – Cumulative Frequency curve from grouped discrete data – Estimating Median and Interquartile range	Students will be able to: Complete a cumulative frequency table and draw a cumulative frequency curve. Use the cumulative frequency curve to estimate Median, quartiles and Interquartile range.	Teacher models completion of cumulative frequency table and drawing of Cumulative Frequency Curve.	Graph Papers Teacher's Handbook	Students to answer standard questions on Cumulative Frequency
Deciles and Percentiles	Students will be able to: estimate deciles and percentiles from Cumulative Frequency graphs.	Teacher Modelling: -Model estimate -How to estimate deciles and percentiles from completed Cumulative Frequency Diagrams.	Completed cumulative frequency diagrams Teacher Handbook	Students answer standard questions on deciles and percentiles.
Statistics - Variance and standard deviation	Students will be able to: Explain that variance is a measure of spread that uses all the data, unlike the interquartile range that uses two values, the upper and lower quartile. Recall that the square root of the variance is called standard deviation. Calculate variance and standard Deviation by use of formulae including standard deviation formulae for frequency distributions and grouped frequency distribution.	Teacher modelling: Model use of formulae to calculate variance and standard deviation.	Teacher Handbook and formulae	Standard questions on Variance and Standard deviation. Probing Questions: You are given several data sets. Some with outliers and some without outliers. If you are to measure spread, explain which ones you will apply the interquartile range to and which ones you will apply the variance to.

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<td>Statistics - Correlation</td>
<td>Students will be able to:

Define correlation

Describe forms of correlation
Draw scatter diagrams

Calculate correlation coefficient by Spearman's rank method

Draw the line and finding the equation of best fit (Regression)</td>
<td>Explain correlation as means of determine the relationship between two variables. Further discuss with the students that the two variables are independent

Demonstrate using the chart to describe the forms of correlation (positive correlation, negative correlation and no correlation)

Illustrate scatter diagram on a graph board with pair values of two variables.

Solve problem with the students to calculate the correlation coefficient using spearman's rank method. *Use data without ties.

$$r = 1 - \frac{6\sum d^2}{n(n^2-1)}$$
$-1 \leq r \leq 1$

Explain the concept of regression line and the equation line of best fit.</td>
<td>Chart showing types of correlation.

Chart -- Line of best fit.2

Chart – illustrating scatter diagram

Electronic Graph board
Graph paper
Blackboard ruler
Foot rule
Markers
Colored chalks
Pencils</td>
<td>Compute the Spearman rank correlation.

<table>
<tr><th>History</th><th>Algebra</th></tr>
<tr><td>35</td><td>30</td></tr>
<tr><td>23</td><td>33</td></tr>
<tr><td>47</td><td>45</td></tr>
<tr><td>17</td><td>23</td></tr>
<tr><td>10</td><td>8</td></tr>
<tr><td>43</td><td>49</td></tr>
<tr><td>9</td><td>12</td></tr>
<tr><td>6</td><td>4</td></tr>
<tr><td>28</td><td>31</td></tr>
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<td colspan="5">YEAR 3/TERM 2</td>
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<td>Probability

Introductory concepts</td>
<td>Students will be able to:

Understand and use simple language of probability [certain, impossible, likely, unlikely, even chance, impossible, outcomes, equally likely]

Understand and use probability scale.

Calculate probability of events happening.</td>
<td>Open discussion: what is probability?

Is it a concept we use in everyday life? Give me examples.

Teacher modelling of:
• Tossing a coin and probability of Tails.
• Tossing a coin and probabilities of Heads
• Probability of getting a '1' or '2' or '3' or '4' or '5' or '6' when a dice is thrown.</td>
<td>Coins
Dice
Counter</td>
<td>Give me three situations where probability is used in everyday life.

Write down or explain two situations where you used probability to make a decision in real-life situation this week.

Can you give me an example of what is meant by 'equally likely outcomes'?</td>
</tr>
</table>

	Draw a sample space diagram for given events. Determine the probability of an event occurring from a sample space diagram.	A sample space of all outcomes when two coins are spun together. Standard questions on probability including probability scale.		The Probability of getting a '3' when a die is thrown is 1/6. Can you explain why? When a coin is tossed, the probability of getting tails is ½. Can you explain why? Give me examples of probabilities for events that could be described using the following words: – Impossible – Certain – Unlikely – Even chance Show these on a Probability Scale.
Probability Theoretical Probability Experimental probability/Relative frequency Mutually exclusive events Expected frequencies	Students will be able to: Explain the difference between Theoretical probability and Experimental Probability/ relative frequency Students understand the term 'mutually exclusive' and can find the probability of Mutually exclusive events.	Teacher Modelling: Theoretical probability is calculated without doing an experiment. Eg Tossing a fair coin. The probability of tails is ½ or 0.5 or 50%. -Probability of getting a six when a dice is cast is 1/6. -Experimental probability is probability obtained by actually carrying out an experiment and involves a repetition of a large number of trials.	Dice Matchboxes Coins	Students answer standard questions with confidence. Probing Questions: A match box is to be used as a die. The two largest faces are each marked with 1 and with 6. The next two largest faces are marked with 2 and with 5 and the two smallest faces are each

	Students can use the fact that the sum of all mutually exclusive outcomes of an event is 1 -use the addition rule of Probability for mutually exclusive events, -calculate expected frequency			marked with 3 and with 4. What two faces will have the largest probability of facing up when the matchbox is thrown as a die? Explain why. Explain how you would estimate the Probability of obtaining a '3' when the matchbox is thrown as a die. Design an experiment you will carry out to estimate the probability that the first car that goes past the school entrance after 8am is a green car.
Probability -Independent events and tree diagrams	Students will be able to: calculate probabilities of repeated events. Draw and use Probability tree diagram students know the term "independent events" use of the multiplication rule for probability P[A and B] = P[A] X P[B]	Teacher Modelling: Explain to students that independent events are events in which the probability of one event occurring does not affect the probability of the other event occurring. Example: getting Heads, when a coin is flipped and obtaining an even number when a die is rolled. Model the construction of a tree diagram for: A box has 4 blue and 6 black yellow counters.	Teacher Handbook Counters	Students answer standard questions on Probability tree diagrams. Probing Questions In a city, 80 people with Coronavirus symptoms were tested for the virus using a new trial kit. 19 people tested positive. The virus only developed in 11 people who tested positive. A total of 67 people did

		A counter is picked at random, the colour noted and then replaced. This is done a second time. List out all possible 4 outcomes i.e.: Blue and Blue Blue and yellow Yellow and blue Yellow and yellow And explain to students that use of a tree diagram will make them avoid missing any combination. Model the multiplication rule for probability of independent events and apply to standard questions on Probability. Emphasise the language of probability when answering questions. E.g. 'both', 'either', 'neither', 'with replacement', 'without replacement', 'at least', 'at most'. Also incorporate the Addition rule for probability when modelling solutions on probability.		not develop the virus at all. Using a tree diagram what is the probability that a person will develop the virus. Give me an example of: a problem which could be solved by adding Probabilities'. a problem which could be solved by multiplying Probabilities. What are the key features of mutually exclusive and independent events on the tree diagram? Why do the Probabilities on each set of branches have to sum up to 1? How can you tell from a completed tree diagram whether the question specified 'with' or 'without' replacement? What strategies do you use to check that Probabilities on your tree diagram are correct?

				Explain to me the steps you took to draw this tree diagram and how to use it to find the probability of this event.
Conditional Probability	Students to: Decide if two events are independent. Draw and use tree diagrams to calculate conditional probability	Teacher Modelling: explain conditional probability as the probability of a dependent event. The probability of the second outcome depends on what has already happened in the first outcome. Model Tree Diagrams from standard Questions and answer standard questions.	Teacher Handbook	Student answer standard questions on conditional probability.

PART 2:

TOPICS FOR ENGINEERING STUDENTS ONLY

YEAR 1/TERM 1				
Logarithmic and exponential Functions	Students will be able to: Apply the laws of indices Solve equations involving indices Apply the laws of logarithms Solve equations involving logarithm and change of base Draw and interpret graphs of exponential relations	Discuss with the students the relation between exponential and indices. i.e. Exponential function $\boldsymbol{f}$ with base $\boldsymbol{a}$ is denoted by $f(x) = a^x$ Where a > 0, a ≠ 1 and x is any real number. *Note to the students that in many applications the most convenient choice for a base is the irrational number $e = 2.718281828$ Discuss the definition of logarithms function with base a. i.e. for $x > 0 \; and 0 < a \neq 1 \quad y = log_a x \; if \; and \; only \; if \; x = a^y$ Hence $f(x) = log_a x$ is the logarithms function with base a. E.g. Simplify $log_5 5^x$ Solve problems with students involving exponential (indices) and logarithm equations E.g. Solve $2(3^{2x-5}) - 4 = 11$ Solve $log_3(5x-1) = log_3(x+7)$ Demonstrate the properties of logarithms. $log_a(UV) = log_a U + log_a V$ $log_a\left(\frac{U}{V}\right) = log_a U - log_a V$	Graph board Graph paper Blackboard ruler Foot rule Markers Colored chalks Pencils	Without using mathematical table simplify the following $\left(\frac{16}{81}\right)^{-\frac{3}{4}}$ ii). $16^{-\frac{3}{2}}$ Find the value of x in the following i). $3^{x^{2-1}} = 9^4$ ii) $3^{2x} - 4(3^x) + 3 = 0$ Simplify the following i). $log_5 10 + log_5 12$ ii) $log_3 24 + log_3 15 - log_3 10$ Solve the following equation $log_{10}(5x+6) = log_{10}(5x - 6)$ ii). $log_{10}(x^2 1) - 2log_{10} x = 1$

		$log_a U^n = n log_a U$ *Note to the students that there is a natural logarithmic function defined by $f(x) = log_a x = \ln x \quad x > 0$		
Inequalities in Linear Programming	Students will be able to: sketch and solve linear inequalities Apply linear inequalities to Linear Programming	Explain symbols involve in Sketching and solving linear inequalities $(<, >, \leq, \& \geq)$ Linear Inequalities e.g. 2x + 5y ≤ 1, x + 3y ≥ 3 Apply linear inequalities to Linear Programming *(optimisation, objective function, constraints and feasible solution)* Solve practical problems to maximize profit.		Inequalities Solve the inequalities: 1. 2 (x – 4) ≥ 3x – 5 2. 7x + 11 > 2x + 5 3. 2(x + 3) < x + 1 4. – 5 ≤ 2x – 7 ≤ 1
Logical reasoning	Students will be able to: identify true or false statements. form true or false statements. determine validity of an argument.	Teacher Modelling: Explain symbols used in logical reasoning.	Teacher Handbook	Students answer standard questions in Logical Reasoning and from Exam Board past papers.
YEAR 1/TERM 2				
Polynomial Functions General Characteristics	Students will be able to: Recognise equations of polynomial functions of degree ≤ 4 Simplify the algebra of polynomial functions	Write the remainder and factor theorem and demonstrate how to apply them in simplifying polynomial Remainder Theorem if a polynomial $f(x)$ is divided by $x - k$, *the remainder is* $r = f(k)$ E.g. Use the remainder theorem to evaluate the function at x = -2	Textbooks Chart showing polynomial functions of degree ≤ 4 a). Linear function b). Quadratic function	The remainder after $2x^2-5x-1$ is divided by x−3

	State and apply the: a). Remainder theorem b). Factor theorem	$f(x) = 3x^3 + 8x^2 + 5x - 7$ Factor Theorem A polynomial $f(x)$has a factor$(x - k)$ if and only if $f(k) = 0$ E.g. Show that $(x - 2) and (x + 3)$ are factors of $f(x) = 2x^4 + 7x^3 - 4x^2 - 27x - 18$	c). Cubic function	the remainder after $2x^2-5x-1$ is divided by x−5 Use the Factor Theorem to find the zeros of $f(x) = x^3 + 4x^2 - 4x - 16$ given that (x-2) is a factor of a polynomial. use the factor theorem to find the zeros of $f(x) = x^3 - 6x^2 - x + 30$. Given that (x+2) is a factor of a polynomial.
Rational Functions and Partial fraction	Students will be able to: Recognize rational function as a quotient of two polynomial functions Apply the four operations on rational functions Decompose rational functions into partial fractions: a) Linear factors in the denominator b) Repeated linear factors in the denominator c) Quadratic factors in the denominator	Teacher to explain to the students that rational function can be written in the form $f(x) = \frac{N(x)}{D(x)}$ Where N(x) and D(x) are polynomials and D(x) is not zero. Solve problems as work examples with the students involving rational functions E.g. Find the domain of the function $f(x) = \frac{4(x+1)}{x(x-4)}$ Decompose into partial fraction $f(x) = \frac{N(x)}{D(x)}$ E.g. Write the partial fraction decomposition of $f(x) = \frac{x+7}{x^2 - x - 6}$		If $f: x \to \frac{1}{2+x}$,find the range if the domain is the set $[x: 1 \leq x \leq 5]$ Simplify the following rational functions $\frac{1}{x-2} + \frac{3}{x+1}$ $\frac{4}{x+2} - \frac{3}{x+3}$ $\frac{2x}{x^2-1} \div \frac{x^2-2x}{x^2-2x+1}$ Resolve $\frac{11-3x}{x^2+2x-3}$ into partial fractions.

				Resolve $\frac{x^2-1}{x^2-3x+2}$ into partial fractions.
The Binomial Theorem Use of the binomial theorem for positive integral index only. Proof of the theorem not required	Students will be able to: Expand powers of binomials using the binomial theorem. Generate co-efficient of binomial expansion by Pascal's triangle.	Discuss the binomial theorem with the students which state that for $(x+y)^0 = 1$ $(x+y)^1 = x+y$ $(x+y)^2 = x^2+2xy+y^2$ $For\ any\ (x+y)^n$ $(x+y)^n = x^n + nx^{n-1}y + \cdots + C_r^n x^{n-r}y^r + \cdots$ Illustrate the Pascal's triangle to generate coefficient of binomial expansion $(x+y)^n$ where n = 0,1,2,3,4… Demonstrate with the students work examples on binomial expansion using both methods. E.g. a). Write the binomial expansion for the expression $(x+1)^3$ b). Find the binomial coefficient $(x+1)^4$	Chart of Pascal's triangle	Use the binomial series to determine the expansion of $(2a - 3b)^5$ Use the binomial series to determine the expansion of $(2+x)^7$ Use Pascal's triangle to expand$(2-y)^7$ Expand $(2a-3b)^5$ using Pascal's triangle Determine, using Pascal's triangle method, the expansion of $(2p-3q)^5$
YEAR 1/TERM 3				
Co-ordinate Geometry Loci	Students will be able to: Describe locus of a point Sketch the locus of points satisfying given conditions State the Locus theorem and how it can be used in real life situations or	Sketch the locus of points satisfying given conditions i). The equation of a curve is the relation that holds true between the coordinates of every point on the curve, and no point that doesn't lie on the curve. ii). To find the equation to a locus, we start by converting the given conditions to mathematical equations.		Example 1 Find the locus of the point moving on a plane which is at a fixed distance 5 units from 'a' the X axis. Example 2 Find the locus of a point which is at a fixed

	activities. Determine the locus of points that will satisfy more than one condition.	Locus Theorems Locus Theorem 1: The locus of points at a fixed distance, d, from point P is a circle with the given point P as its center and d as its radius. Locus Theorem 2: The locus of points at a fixed distance, d, from a line, l, is a pair of parallel lines d distance from l and on either side of l. Locus Theorem 3: The locus of points equidistant from two points is the perpendicular bisector of the line segment determined by the two points. Locus Theorem 4: The locus of points equidistant from two parallel lines Locus Theorem 5: The locus of points equidistant from two intersecting lines Equation to a locus "The equation of a curve is the relation which exists between the coordinates of all points on the curve, and which does not hold for any point not on the curve". Finding out the equation to a locus means finding out the relation that holds true between the x and y coordinates of *all* points on the locus.		distance 4 from the origin Example 3 Find the locus of a point such that it is equidistant from two fixed points, A(1, 1) and B(2, 4)
Straight Lines	Students will be able to: Plot a point on a plane	Describe the Cartesian coordinate system (x-and –y-axes). Demonstrate on a graph board to plot points.		Organize students in pairs or groups. Ask simple multiple-choice question.

	Define a straight line as a locus of points described by the equation *y* = *mx* + *c* Find the: • Distance between two points • Gradient of a line joining two points mid-point of a line segment (mid-point formula) • Divide a line segment in a given ratio (externally and internally) • Equation of a straight line • Equations of parallel and perpendicular lines • Perpendicular distance from a line • Acute angle between two intersecting lines	Explain the meaning of the variables on the straight line $y = mx + c$ Solve problems on the distance between two given points $(x_1, y_2) and\ (x_2, y_2)$ using the formula d =$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ solve the gradient of the two points $(x_1, y_2) and\ (x_2, y_2)$ using gradient $= \frac{y_2 - y_1}{x_2 - x_1}$ Solve a problem on division of line segment in the ratio $m{:}n$ at the points $(x_1, y_2) and\ (x_2, y_2)$ use the relation $\left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}\right)$ Solve problems on acute angle between lines		Give simple class work. Example. $A(3, 4)\ and\ B(5, 9)$ are two point on a straight. Compute: a) the distance b) the slope c) mid-point Example. $A(3, 4)\ and\ B(5, 9)$ are two point on a straight. Compute the equation of the line, Conduct quizzes and examinations.
Circles	Students will be able to: Define a circle as a locus of points that are a fixed distance from a given point (centre) Solve problems on i. center and radius given the equation of a circle	Describe a circle and state the general equation of a circle. Teacher solves problems on finding the radius $r = \sqrt{g^2 + f^2 - c}$ and the center $(-g, -f)$ from the general equation $x^2 + y^2 + 2gx + 2fy + c = 0$ Solve problems on tangents and normal to a curve		Arrange pupils in groups and give them tasks to do. Example 1). Find the center and radius of the circle $x^2 + y^2 - 3x + 4y = 8$. 2). Sketch the circle whose general equation is

	ii. equations of tangent and normal to a circle			$2x^2 + 2y^2 - 3x + 16y = 8$. 3). Find the equation of the tangent to the circle$x^2 + y^2 - 2x + 4y - 1 = 0$. Conduct quizzes and tests
Parabolas	Students will be able to: Define a parabola as a locus of points equidistant from a fixed point (focus) and a fixed line (directrix) Find the equation of a parabola Sketch a parabola given turning points, intercepts, and axis of symmetry Find the equations of : i. tangent and normal to a parabola ii. the axis of symmetry	Explain the meaning of a parabola and discusses the shape of the curve when different conditions are given conditions Teacher demonstrates how to sketch a parabola on a graph board Solve problems on tangents and normal to a parabola		Ask simple question about parabolas and record their responses on the board. Organize in groups and give tasks to do in class. Example 1. Find the standard form of the equation of the parabola with vertex $(2, 3)$ and focus $(1, 2)$. Example 2. Find the equation of the tangent line to the parabola $y = x^2$ at the point $(1, -1)$
Trigonometry Trigonometric Ratios and Rules	Students will be able to: Find sine, cosine and tangent of angles $0^o \leq \Theta \leq 360^o$ in general and 0^o, 30^o, 45^o, 60^o and 90^o in particular	Use the right triangle to derive the three basic trigonometric ratios and their corresponding reciprocals Explain the use of the right triangle to give the relationships between the trigonometric ratios. $\tan x = \frac{\sin x}{\cos x}$,		Ask students to name the basic trigonometric ratios. Arrange in groups and give the simple task to do whilst you move

	Use the basic trigonometric ratios and reciprocals to prove given trigonometric identities Evaluate the sine, cosine and tangent of negative angles Convert degrees into radians and vice versa Apply trigonometric ratios and rules to real-life situations	$\sin x = \cos(90 - x)$ $\sec x = \frac{1}{\cos x}$etc. Explain the use of the quadrants for the sign of each trigonometric ratio. Solve simple problems on elevation and depression.		around helping struggling students. Example. Evaluate $\cos 225^0$, $\sin 300^0$ Example. Convert 330^0 into radian Convert 4π into degrees
Trigonometric Functions and identities	Students will be able to: Use trigonometric identities to solve equations. Draw graphs of sine, cosine and tangent ratios in degrees and radians and recognize their periodic nature over an extended domain Use graphs to solve trigonometric functions up to quadratics, within a specified domain Calculate the maximum and minimum points of given trigonometric functions	Explain and solve trigonometric equations Draw graphs of the three basic trigonometric ratios and explain their nature and use the graphs to solve trigonometric equations		Give class work. Ask a pupil to come to the board and solve a given exercise. Example. Solve the equation $2\sin x - 3\cos x = 1$ for $0 \leq x \leq 180$ Example. Sole the equation $\sin 2x = \cos 5x$ Example. Draw the graph of $y = \sin x$ for $0 \leq x \leq 2\pi$

Graphs of Trigonometric functions	Students to recognise: the shapes and draw simple graphs of y = Sin x, y=COS x and Cos solve simple equations. Students will be able to: draw graphs of the type: Y= a Cos + b Sin and solve simple equations from graphs.	Teacher Modelling: Model plotting of plots and drawing graphs of y = Sin x and y = Cos x	Teacher Handbook Graph paper	Standard questions on trigonometric graphs. Probing Questions: Why does the graph of y = SinX start at 0 within the range of $0^0$and 360^0. Why does the graph y = Cosx start at ii within the range of $0^0$and 360^0
YEAR 2/TERM 1				
Limits Definition of Limit of a function Limit properties – Limits of constant – Limits of the function x^k – Limits of the function x – Limits of the function $\dot{k}x$ – Limits of the function $f(x).g(x)$ – Limits of rational functions – Limits involving infinity	Students should be able: Define the concept of limits of a function. Apply the limit property to evaluate given functions i). If $\lim_{x \to a} f(x) = k$ where k is a constant, then $\lim_{x \to a} k = k$ ii). $\lim_{x \to a} x^k = a^k$ iii). $\lim_{x \to a} x = a$ iv). $\lim_{x \to a} kx = ka$ v). $\lim_{x \to a} f(x).g(x) =$ $\lim_{x \to a} f(x) . \lim_{x \to a} g(x)$ $=$ $f(a).g(a)$ vi). $f(x) = \frac{g(x)}{h(x)}$, then $\lim_{x \to a} f(x) = \frac{\lim_{x \to a} g(x)}{\lim_{x \to a} h(x)} = \frac{g(a)}{h(a)}$	Teacher to explain the concept of limits Discuss with the students the properties or theorem of limits with given examples Example: Find $\lim_{x \to 2}(x+3)(x^2-5)$ Solve problems with students involving application of limit properties	White board	Evaluate 1. $\lim_{x \to 2} x^3 = 2^3$ 2. $\lim_{x \to 2} x = 2$ 3. $\lim_{x \to 5} 3x = 3(5)$ 4. $\lim_{x \to 2}(x^2 - 4x + 2)$ 5. $\lim_{x \to 2}\left\{\frac{x^2-7x+10}{x^2-4}\right\}$ 6. $\lim_{x \to \infty}\left\{\frac{5x^2-1)}{2x^2+1}\right\}$

	vii). $\lim_{n\to\infty} f(x)$.			
Introduction to Derivatives Find the derivative of simple functions.	Students will be able to: Define the derivative of a function Find the derivative of simple function.	Ask questions about the meaning of a straight line between two points(x_1, y_1) and (x_2, y_2) Record various responses from pupils on the board. Gradient=$\frac{increase\ y}{increase\ x} = \frac{y_2-y_1}{x_2-x_1}$ Teacher explains that small increments were added to both x and y then $\frac{\Delta y}{\Delta x} = \frac{f(x+\Delta x)-f(x)}{\Delta x}$. Write the notations of differentiation $\frac{dy}{dx}$ or $f^1(x)$ all denoting first differentials Solve problems with students involving derivative of a function.	Electronics graph board Graph boards Rulers Graph papers	Give class work. E.g. Differentiate from first principles the function $y = x^2$. Ask pupils to explain how they arrive at the answer
Methods of Differentiation Differentiate a function using first principle. Common functions Product rule of differentiation Quotient rule differentiation	Students will be able to: Use the idea of limits to differentiate a function from first principles. Differentiate common functions Differentiate a product using product rule. Eg. If $y = uv$ $then\ \frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$	Teacher explains the method of finding derivative of function by first principles. Discuss with students how to differentiate common functions such as: $y = c, y = x^n$, etc Teacher can further discuss with pupils through questioning the meanings of product and quotient of numbers. Apply the product and quotient rule to Differentiate functions Eg. If $y = (2x - 2)(2x^3)$ (Product rule)	White board Textbooks	Group pupils and give them class activities on the concepts taught. E.g., Use the quotient rule to find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for $y = \frac{2x}{x+5}$.

Chain rule (also known as function of a function) Successive differentiation (higher derivatives)	Eg. If y = $\frac{u}{v}$ $then\ \frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$ Differentiate a function of a function. $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$ Differentiate a function successively. Eg. $\frac{d^2y}{dx^2}$	Eg. If y= $\frac{(2x-2)}{(2x^3)}$ (Quotient rule) Solve problems on Differentiating function of a function. Teacher to introduce higher or successive differentiation.		
Implicit Differentiation How to differentiate function of another function	Students will be able to: Use the chain rule to differentiate implicitly Find the slope of a curve at a given point. Apply the concept of implicit differentiation to find the equation of a tangent to a curve at a given point.	Explain the meaning of implicit functions. Eg $x^2 - 3xy^2 - y = 6$ Explain to pupils how to differentiate implicitly Solve problems on implicit differentiating as work examples		Group pupils in pairs and ask them to solve some problems Eg. Find $\frac{dy}{dx}$ for the function$2x^2 - 3xy = 7$.
Derivative of Trig Functions How to determine the derivative of a trigonometric function with a given function.	Students will be able to: Compute the differentials of trigonometric functions Apply the techniques of differentiation to calculate the differentials of trigonometric functions	Discuss with pupils the three basic trigonometric ratios $(\sin x . \cos x\ and\ \tan x)$ with their corresponding reciprocals $(\csc x . \sec x\ and\ \cot x)$ using the right-triangle. Solve problems on Differentiating trigonometric ratios applying the techniques of differentiation.		Ask pupils to list the trigonometric ratios. Record their responses on the board. Ask pupils to find the differential coefficient of $y = \sin x$. Ask one or two pupils to try and solve it on the board.

Differentiation of natural log functions and exponential functions	Differentiate composite trigonometric functions. Differentiate logarithmic functions. Such as $y = \log_e(2x-5)$	Solve problems on Differentiating logarithmic and exponential functions applying the techniques of differentiation.		
Applications of differentiation Increasing and decreasing functions Rates of change, velocity and acceleration, Turning points (maximum and minimum) Points of inflexion Tangents and normal Practical problems	Students will be able to: Describe an increasing and decreasing function. Apply differentiation to determine I. rates of change II. velocity and acceleration III. (maximum and minimum) IV. Tangents and normal V. Practical problems	Teacher to discuss with the students meaning of rate of change, Velocity and acceleration, Turning points (maximum and minimum). Explain that at a turning point $\frac{dy}{dx} = 0$. Solve problems as work examples on some application of differentiation.		Ask pupils to explain velocity and acceleration. Give pupils some class work for them to try. Find the maxima and minima points of the function$y = (2x-1)(4-x)^2$.
Integration Process of Integration The general solution of 1. Indefinite integral 2. Definite integral	Students will be able to: define integration as the reverse of differentiation Determine the integrals of the form x^n and ax^n. Where n is a fractional, zero, or positive or negative integer.. $\int x^n\,dx = \frac{x^{n+1}}{n+1} + c$ (indefinite integral)	Explain to pupils the meaning of integration and he notation for integration as $\int$ Solve problems on indefinite integrals $\int x^n\,dx = \frac{x^{n+1}}{n+1} + c$. C is the arbitrary constant also known as the constant of integration. Explain the concept of definite integral$[x]_a^b = (b) - (a)$. Solve some mathematical problems on the definite and indefinite integrals.		Ask pupils to give the difference between differentiation and integration Give pupils (groups) exercises to try in class. E.g. integrate x^2 E.g. find $\int_1^2 (3x-4)\,dx$

	$[x]_a^b = (b) - (a)$ (Definite integral)			
Techniques of integration Introduction to integration of Trigonometric Functions. Integration by substitution Integration of Logarithmic functions Integration of exponential functions.	Students will be able to: Integrate simple trigonometric functions $\int \sin x\, dx$. Integrate functions by substitution method Integrate logarithmic functions ($\int \ln x\, dx$) Integrate exponential functions ($\int e^x\, dx$)	Ask pupils to state the basic trigonometric ratios. Explain and guide pupils to integrate trigonometric functions. Discuss with pupils the process of substitution in integration. Explain how to integrate logarithmic and exponential functions.		Integrate $\sin x$ and $\cos x$. E.g. Find $\int \frac{1}{2x} dx$.
Some applications of integration Area under curves Numerical integration	Students will be able to: Apply integration to calculate areas under curves Apply the trapezoidal rule to evaluate the area under a curve	Discuss the concept of definite integral to find the area $\left(\int_a^b f(x)\, dx \text{ or } \int_a^b y\, dx\right)$ and the volume of a solid obtained by rotating the area bounded by the curve $\left(V = \pi \int_a^b (f(x))^2\, dx\right)$ Explain the use of trapezium rule. Solve problems on the applications.		Give class work to pupils whilst you walk around supervising. E.g. Find the area bounded by the curve $y = 4x^2$, the x-axis and the ordinates x=0 and x=1
YEAR 2/TERM 2				
Angles of elevation/depression	Students will be able to: Calculate angles of elevation and depression and other related heights and distances.	Teacher Modelling: a practical approach is recommended for this lesson.	Clinometer Improvised clinometers	Students to answer standard questions on angles of elevation and depression.

		students can work outdoors using clinometers or improvised clinometers using protractors and paper tubes.		
Bearings	Students will be able to: understand the concept and language of bearings. represent practical situations using sketches calculate bearings and related distances.	Initial practical approach is recommended. Students work outside and model bearings using Map compasses	Map Compasses Measuring instruments E.g., Trundle wheel Tape Measures	Students answer standard question on bearings.
Circle Theorems	Students to know the circle theorems and be able to do calculations involving circle theorems with reasons	Teacher Modelling: Model the circle theorems involving 1. Angles at the centre and at the circumference 2. Angles in the same segment 3. Angles in a semi-circle 4. Angles in the alternate segment 5. Cyclic quadrilateral 6. Tangents to a circle Mention angle between radius and tangent at point of contact is a right angle. Do calculations involving length of chords and distances of chords from centre of circle.	Teacher Handbook	Students to answer standard questions on circle theorems. Probing Questions: Write answers for a series of questions on circle theorems that have wrong calculations, using wrong theorems with poor, unclear and incomplete reasons. Their task is to rewrite the answers with correct calculations supported by correct theorems and with clear, complete reasons.
Area of sector and length of arc	Students will be able to:	Teacher Modelling	Teacher Handbook	

	calculate area of sector and length of arc by use of formulae. Calculate area of segment using area of triangle =½abSin C Students to know that when a sector in folded, it forms a cone and appreciate the relationship between: [a]the area of the sector and the curved surface area of the cone. [b]the radius of the arc and the slant edge of the cone. Students to understand the relationship between the length of the arc and the circumference of the base circle of the cone which it makes when folded.	Use circular filter paper to cut out sector for demonstration purpose Model questions on calculating area of segment. Area of segment = Area of sector – Area of Triangle	Circular filter paper	
Similarities	Students will be able to: Explain that shapes are similar when one is an enlargement of the other and that corresponding sides and angles are all in the same ratio. Work out ratio of corresponding sides to work out scale factor.	Teacher Modelling Model the relationships 1. Small length x Scale Factor = Large length 2. Small Area x (Scale Factor)^2= Large Area Small Volume x (Scale factor)^3= Large Volume	Teacher Handbook	Students answer standard questions on Similarity. Probing Questions: What is frustum? Give me five examples of Frustum you will see in your local environment.

	Calculate length, area and volume of similar figures Use similarity to calculate volume of frustum.			
YEAR 2/TERM 3				
Statics Resultant and resolving forces into components Equilibrium of coplanar forces Types of forces (weight, tension and trust) Friction and coefficient of friction	Students will be able to: Explain the meaning of statics Resolve forces and calculate the resultant force Solve problems on the equilibrium of coplanar forces Explain friction and resolve a contact force into normal and frictional components	Discuss the meaning of statics. Explain the resultant of forces and help students to resolve a force into components forces and compute the resultant force. $R = \sqrt{X^2 + Y^2}$, where X = horizontal component Y = vertical component Explain coplanar forces and solve some problems Discuss friction and demonstrate the resolution of the normal and friction components Use the relation $F = \mu R$ to solve friction related problems		Organize students in groups and give them class exercises Example. A force F acts on a particle at an angle of θ to the horizontal. Find the horizontal and vertical components of F when F = 20N and $\theta = 20^0$. Ask students to explain the types of forces.
Kinematics of a particle Speed, time distance velocity and acceleration.	Students will be able to: Define kinematics and other related terminologies and state their unit of measurement. Derive the equations of linear motion with uniform acceleration Solve problems on acceleration due to gravity	Explain terminologies on uniform motion *(displacement, velocity, acceleration, distance, speed)* Apply the definitions of the terminologies to derive the equations of uniformly accelerated motion. That is $a = \frac{v-u}{t}$ $v^2 = u^2 + 2as.$ $s = \left(\frac{u+v}{2}\right)t.$		Ask students to define speed, velocity, distance, displacement, and acceleration. Record their answers on the board. Group them and give work to do in class. Example. A particle is moving in a straight line with uniform acceleration. If it travels

	Solve uniform accelerated motion problems graphically	$s = ut + \frac{1}{2}at^2$. Solve problems on uniform motion graphically Apply the concept of uniformly accelerated motion to solve problems on vertical motion.		120m while increasing speed from $5ms^{-1}\ to\ 25ms^{-1}$ find its acceleration. Conduct quizzes and tests
Dynamics Moment of inertia of a particle and rigid body Newton's laws of motion Motion of two connected particles Momentum and impulse Sum of moments Equilibrium of a lamina under parallel forces	Students will be able to: Define a rigid body State and explain Newton's laws of motion Solve problems using Newton's laws of motion Explain the meanings of momentum and impulse and how they are related Solve problems on conservation of linear momentum	Define and explain rigid body Explain that moment of inertia of rigid body = sum of moments of inertia all the particles present in the body, ie $I = m_1{r^2}_1 + m_2{r^2}_2 + + \cdots$.. $\rightarrow I = \sum mr^2$. Discuss Newton's laws of motion with practical examples Establish the relationship between impulse and momentum. That is impulse = change momentum, $I = m(v - u)$ Explain the principle of conservation of momentum. That is Total momentum before impact = total momentum after impact or $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$		Ask students to state and explain the laws of motion Organize students in groups and administer task to do. Example. Find the resultant force which will produce an acceleration of $5ms^{-2}$ for a particle of 6kg. Example A car of mass 800kg decelerates from $20ms^{-1}$ to $5ms^{-1}$. Find the loss of momentum.

YEAR 3/TERM 1				
Vectors Vectors and scalars Properties of vectors (representing vectors, equal vectors, null or zero vector) The magnitude and direction of a vector Algebra of vectors Triangle law of vector addition	Students will be able to: Describe vector and scalar quantities Write the notations for a vector and represent a vector on the rectangular Cartesian co-ordinate system. Compute the magnitude and direction a vector Apply the algebra of vectors including:(addition, subtraction and scalar multiplication of vectors) Use the geometric applications of vectors on i. the triangle ii. the parallelogram and other polygons using the laws of addition and subtraction of vectors	Explain vectors and scalars quantities with given examples to each demonstrate the representation of vectors on a Cartesian plane using the graph Discusses the various ways of notating a vector. E.g. $\overrightarrow{AB}$ (directed line segment joining two points from A to B) or as components of a point that is $\binom{x}{y}$. Bold type letter is another way of notating a vector. Calculate the magnitude as $\lvert\overrightarrow{AB}\rvert = \sqrt{X^2 + Y^2}$ and the direction as $\theta = \tan^{-1}\left(\frac{Y}{X}\right)$ Discuss the geometric approach to solve vector problems using the triangle law of vector addition.		Ask students to give examples of vector and scalar quantities. Record all responses on the board Ask them to represent a vector on the board Give them group work. Example. A girl walks xkm due east then zkm north-east. Calculate the total distance she has walked and her displacement from her starting point when $x = 3\ and\ z = 4$
YEAR 3/TERM 2				
Matrices Operations on matrices Finding the determinant and	Students will be able to: Explain what a matrix is and its applications. Identify the order of a matrix and the types of matrices.	Teacher Modelling Explain matrices and their applications Types of matrices eg Row Matrix, column matrix, null matrix, square matrix, diagonal matrix, unit or Identity matrix.	Teacher Handbook Examples of large data that can be stored in a form of a matrix.	Standard Question on Matrices Probing Questions: If the determinant of a matrix is zero, what does that tell you about the matrix.

inverse of a matrix (limited to 2 x 2 matrices) Application of matrices (Cramer's rule) to solve simultaneous linear equations in two variables	Perform addition, subtraction, scalar multiplication and multiplication of matrices. Solve problems involving -Transposition of Matrices -Determinant of a(2x2) Matrix. -Inverse of a (2x2) matrix -Equality of Matrices	Model addition, subtraction scalar multiplication and multiplication of matrices. Model the use of simultaneous equations to solve problems involving equality of matrices.		What is the determinant of a singular matrix? When a matrix is multiplied by its determinant, the result is the Unit of Matrix. True or False? Convince me.
Linear Transformations The concept of linear transformation Images of points under given linear transformation	Students will be able to: Reflect 2D shapes on graph paper given the equation of the line of reflection. Rotate a shape on graph paper giving the centre of rotation and the angle and direction of rotation. Translate a shape on graph paper given the Vector Translation. Enlarge a shape given the centre of rotation and the scale factor. Students will be able to: describe transformation.	Teacher Modelling Model reflection along the x-axis the y-axis, x=2, axis and y= x axis etc. Point out to students that the image and object will have the same distance from the line of reflection. Mirrors could be used to support understanding. When reflecting along a diagonal line [y=x or y=-x], point out that you count the number of steps needed to get to the line from any point using the scale on the y-axis and when you reach the line you bend away from the line and count the same number of steps from the line to locate your point. Each point is done one at a time. When modelling notation explain what clockwise rotation is and use tracing paper to rotate the shape accordingly around the centre of rotation. When modelling transformation explain the column vector Notation. [^{x}y]	Teacher Handbook Graph Paper Mirrors	Standard Questions on Transformation Probing Questions: When describing a reflection what are the key elements that must be specified? When describing a rotation what are the key elements that must be specified? When describing a translation, what key elements must be specified? When describing enlargement, what key elements must be specified?

		E.g. when asked to translate a shape by vectors $\begin{bmatrix}3\\2\end{bmatrix}$ It means move the shape 3 steps to the right along the x-axis and then 2 steps upwards along the y-axis. Similarly, a translation by Vector $\begin{bmatrix}-3\\-2\end{bmatrix}$ means move the shape 3 steps to the left along the x-axis and then two steps downwards along the y-axis. Tracing paper can also be used to trace the shape and moved according to the required vector translation. When modelling enlargement make sure the centre of enlargement and the scale factor are included. The distance from the centre to each point on the shape is multiplied by the scale factor.		A reflection in one axis followed by a reflection in the other axis is the same as a rotation. Decide whether this statement is sometimes, always or never true. When a shape is enlarged with a scale factor 3, what happens to its area?

TOPICS FOR PHYSICAL SCIENCES STUDENTS ONLY

YEAR 1/TERM 1				
Logarithmic and exponential Functions	Students will be able to: Apply the laws of indices Solve equations involving indices Apply the laws of logarithms Solve equations involving logarithm and change of base	Discuss with students the relation between exponential and indices. i.e. Exponential function $\boldsymbol{f}$ with base $\boldsymbol{a}$ is denoted by $f(x) = a^x$ Where a $>$ 0, a $\neq 1$ and x is any real number. *Note to the students that in many applications the most convenient choice for a base is the irrational number $e = 2.718281828$	Graph board Graph paper Blackboard ruler Foot rule Markers Colored chalks Pencils	Without using mathematical table simplify the following 1). $\left(\frac{16}{81}\right)^{-\frac{3}{4}}$ ii). $16^{-\frac{3}{2}}$ Find the value of x in the following i). $3^{x^2-1} = 9^4$ ii) $3^{2x} - 4(3^x) + 3 = 0$ Simplify the following i). $log_5 10 + log_5 12$

	Draw and interpret graphs of exponential relations	Discuss the definition of logarithms function with base a. Ie for $x > 0\ and 0 < a \neq 1 \quad y = log_a x\ if\ and\ only\ if\ x = a^y$ Hence $f(x) = log_a x$ is the logarithms function with base a. Eg. Simplify $log_5 5^x$ Solve problems with students involving exponential (indices) and logarithm equations Eg. Solve $2(3^{2x-5}) - 4 = 11$ Solve $log_3(5x-1) = log_3(x+7)$ Demonstrate the properties of logarithms. $log_a(UV) = log_a U + log_a V$ $log_a\left(\frac{U}{V}\right) = log_a U - log_a V$ $log_a U^n = n log_a U$ *Note to the students that there is a natural logarithmic function defined by $f(x) = log_a x = \ln x \quad x > 0$		ii) $log_3 24 + log_3 15 - log_3 10$ Solve the following equation $log_{10}(5x+6) = log_{10}(5x - 6)$ ii). $log_{10}(x^2 1) - 2log_{10} x = 1$
Logical reasoning	Students will be able to: identify true or false statements. form true or false statements. determine validity of an argument.	Teacher Modelling: Explain symbols used in logical reasoning.	Teacher Handbook	Students answer standard questions in logical reasoning and from Exam Board past papers.

YEAR 1/TERM 2				
Polynomial Functions General Characteristics	Students will be able to: Recognise equations of polynomial functions of degree ≤ 4 Simplify the algebra of polynomial functions State and apply the: a). Remainder theorem b). Factor theorem	Write the remainder and factor theorem and demonstrate how to apply them in simplifying polynomial **Remainder Theorem** if a polynomial $f(x)$ is divided by $x-k, the\ remainder\ is$ $r = f(k)$ Eg. Use the remainder theorem to evaluate the function at x = -2 $f(x) = 3x^3 + 8x^2 + 5x - 7$ **Factor Theorem** A polynomial $f(x)$has a factor$(x-k)$ if and only if $f(k) = 0$ Eg. Show that $(x-2) and (x+3)$ are factors of $f(x) = 2x^4 + 7x^3 - 4x^2 - 27x - 18$	Textbooks Chart showing polynomial functions of degree ≤ 4 a). Linear function b). Quadratic function c). Cubic function	i). The remainder after $2x^2-5x-1$ is divided by $x-3$ ii). the remainder after $2x^2-5x-1$ is divided by $x-5$ iii). Use the Factor Theorem to find the zeros of $\boldsymbol{f(x) = x^3 + 4x^2 - 4x - 16}$ given that (x-2) is a factor of a polynomial. iv. use the factor theorem to find the zeros of $\boldsymbol{f(x) = x^3 - 6x^2 - x + 30}$. Given that (x+2) is a factor of a polynomial.
Partial fraction	Students will be able to: Recognize rational function as a quotient of two polynomial functions Apply the four operations on rational functions Decompose rational functions into partial fractions: Linear factors in the denominator	Teacher to explain to the students that rational function can be written in the form $f(x) = \frac{N(x)}{D(x)}$ Where N(x) and D(x) are polynomials and D(x) is not zero. Solve problems as work examples with the students involving rational functions Eg. Find the domain of the function $f(x) = \frac{4(x+1)}{x(x-4)}$ Decompose into partial fraction $f(x) = \frac{N(x)}{D(x)}$		1). If $f: x \to \frac{1}{2+x}$,find the range if the domain is the set $[x: 1 \leq x \leq 5]$ 2). Simplify the following rational functions $\frac{1}{x-2} + \frac{3}{x+1}$ $\frac{4}{x+2} - \frac{3}{x+3}$ $\frac{2x}{x^2-1} \div \frac{x^2-2x}{x^2-2x+1}$

	Repeated linear factors in the denominator Quadratic factors in the denominator	Eg. Write the partial fraction decomposition of $$f(x) = \frac{x+7}{x^2 - x - 6}$$		Resolve $\frac{11 - 3x}{x^2 + 2x - 3}$ into partial fractions. Resolve $\frac{x^2 - 1}{x^2 - 3x + 2}$ into partial fractions.
Exponential function	Students will be able to: Apply the laws of indices Solve equations involving indices	Discuss with students the relation between exponential and indices. i.e Exponential function $\boldsymbol{f}$ with base $\boldsymbol{a}$ is denoted by $$f(x) = a^x$$ Where a $>$ 0, a $\neq 1$ and x is any real number. *Note to the students that in many applications the most convenient choice for a base is the irrational number $e = 2.718281828$	Graph board Graph paper Blackboard ruler Foot rule Markers Colored chalks Pencils	Without using mathematical table simplify the following 1). $\left(\frac{16}{81}\right)^{-\frac{3}{4}}$ ii). $16^{-\frac{3}{2}}$ Find the value of x in the following i). $3^{x^2-1} = 9^4$ ii) $3^{2x} - 4(3^x) + 3 = 0$ Simplify the following i). $log_5 10 + log_5 12$ ii) $log_3 24 + log_3 15 - log_3 10$ Solve the following equation $log_{10}(5x + 6) = log_{10}(5x - 6)$ ii). $log_{10}(x^2 1) - 2log_{10} x = 1$

YEAR 1/TERM 3				
Polynomial Functions Logarithmic Function	Apply the laws of logarithms Solve equations involving logarithm and change of base Draw and interpret graphs of exponential relations	Discuss the definition of logarithms function with base a. Ie for $x > 0\ and 0 < a \neq 1 \quad y = log_a x\ if\ and\ only\ if\ x = a^y$ Hence $f(x) = log_a x$ is the logarithms function with base a. Eg. Simplify $log_5 5^x$ Solve problems with students involving exponential (indices) and logarithm equations Eg. Solve $2(3^{2x-5}) - 4 = 11$ Solve $log_3(5x - 1) = log_3(x + 7)$ Demonstrate the properties of logarithms. $log_a(UV) = log_a U + log_a V$ $log_a\left(\frac{U}{V}\right) = log_a U - log_a V$ $log_a U^n = n log_a U$ *Note to the students that there is a natural logarithmic function defined by $f(x) = log_e x = \ln x \quad x > 0$		
The Binomial Theorem Use of the binomial theorem for positive integral index only. Proof of the theorem **<u>not required</u>**	Students will be able to: Expand powers of binomials using the binomial theorem. Generate co-efficient of binomial expansion by Pascal's triangle.	Discuss the binomial theorem which states that for $(x + y)^0 = 1$ $(x + y)^1 = x + y$ $(x + y)^2 = x^2 + 2xy + y^2$ $For\ any\ (x + y)^n$ $(x + y)^n = x^n + nx^{n-1}y + \cdots + C_r^n x^{n-r}y^r + \cdots$	Chart of Pascal's triangle	Use the binomial series to determine the expansion of $(2a - 3b)^5$ Use the binomial series to determine the expansion of $(2 + x)^7$ Use Pascal's triangle to expand$(2 - y)^7$

		Illustrate the Pascal's triangle to generate coefficient of binomial expansion $(x+y)^n$ where n = 0,1,2,3,4… Demonstrate with the students work examples on binomial expansion using both methods. Examples. a). Write the binomial expansion for the expression $(x+1)^3$ b). Find the binomial coefficient $(x+1)^4$		Expand $(2a-3b)^5$ using Pascal's triangle Determine, using Pascal's triangle method, the expansion of $(2p-3q)^5$
YEAR 2/TERM 1				
Limits Definition of Limit of a function Limit properties – Limits of constant – Limits of the function x^k – Limits of the function x – Limits of the function $\dot{k}x$ – Limits of the function $f(x).g(x)$ – Limits of rational functions – Limits involving infinity	Students should be able: Define the concept of limits of a function. Apply the limit property to evaluate given functions: i). If $\lim_{x\to a} f(x) = k$ where k is a constant, then $\lim_{x\to a} k = k$ ii). $\lim_{x\to a} x^k = a^k$ iii). $\lim_{x\to a} x = a$ iv). $\lim_{x\to a} kx = ka$ v). $\lim_{x\to a} f(x).g(x) =$ $\lim_{x\to a} f(x) . \lim_{x\to a} g(x)$ $=$ $f(a).g(a)$ vi). $f(x) = \frac{g(x)}{h(x)}$, then $\lim_{x\to a} f(x) = \frac{\lim_{x\to a} g(x)}{\lim_{x\to a} h(x)} = \frac{g(a)}{h(a)}$ vii). $\lim_{n\to\infty} f(x)$.	Teacher to explain the concept of limits Discuss with the students the properties or theorem of limits with given examples Example: Find $\lim_{x\to 2}(x+3)(x^2-5)$ Solve problems involving application of limit properties with the students	White board	Evaluate 1. $\lim_{x\to 2} x^3 = 2^3$ 2. $\lim_{x\to 2} x = 2$ 3. $\lim_{x\to 5} 3x = 3(5)$ 4. $\lim_{x\to 2}(x^2-4x+2)$ 5. $\lim_{x\to 2}\left\{\frac{x^2-7x+10}{x^2-4}\right\}$ 6. $\lim_{x\to\infty}\left\{\frac{5x^2-1)}{2x^2+1}\right\}$

Introduction to Derivatives Find the derivative of simple functions.	Students will be able to: Define the derivative of a function Find the derivative of simple function.	Ask questions about the meaning of a straight line between two points(x_1, y_1) and (x_2, y_2) Record various responses from pupils on the board. Gradient=$\frac{increase\ y}{increase\ x} = \frac{y_2 - y_1}{x_2 - x_1}$ Teacher explains that small increments were added to both x and y then $\frac{\Delta y}{\Delta x} = \frac{f(x+\Delta x) - f(x)}{\Delta x}$. Write the notations of differentiation $\frac{dy}{dx}$ or $f^1(x)$ all denoting first differentials Solve problems with the students involving derivative of a function.	Electronics graph board Graph boards Rulers Graph papers	Give class work. E.g. Differentiate from first principles the function $y = x^2$. Ask pupils to explain how they arrive at the answer
Methods of Differentiation Differentiate a function using first principle. Common functions Product rule of differentiation Quotient rule differentiation Chain rule (also known as function of a function)	Students will be able to: Use the idea of limits to differentiate a function from first principles. Differentiate common functions Differentiate a product using product rule. Eg. If $y = uv$ $then\ \frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$ Eg. If y = $\frac{u}{v}$	Teacher explains the method of finding derivative of function by first principles. Teacher discuss with students how to differentiate common functions such as : $y = c, y = x^n$, etc Teacher can further discuss with pupils through questioning the meanings of product and quotient of numbers. Apply the product and quotient rule to Differentiate functions Eg. If $y = (2x - 2)(2x^3)$ (Product rule) Eg. If y= $\frac{(2x-2)}{(2x^3)}$ (Quotient rule)	White board textbooks	Group pupils and give them class activities on the concepts taught. E.g. Use the quotient rule to find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for $y = \frac{2x}{x+5}$.

Successive differentiation (higher derivatives)	$then \frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$ Differentiate a function of a function. $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$ Differentiate a function successively. Eg. $\frac{d^2y}{dx^2}$	Solve problems on Differentiating function of a function. Teacher to introduce higher or successive differentiation.		
Implicit Differentiation How to differentiate function of another function	Students will be able to: Use the chain rule to differentiate implicitly Find the slope of a curve at a given point. Apply the concept of implicit differentiation to find the equation of a tangent to a curve at a given point.	Explain the meaning of implicit functions. Eg $x^2 - 3xy^2 - y = 6$ Explain to pupils how to differentiate implicitly Solve problems on implicit Differentiating as work examples		Group pupils in pairs and ask them to solve some problems Eg. Find $\frac{dy}{dx}$ for the function$2x^2 - 3xy = 7$.
Derivative of Trig Functions How to determine the derivative of a trigonometric function with a given function. Differentiation of natural log functions	Students will be able to: Compute the differentials of trigonometric functions Apply the techniques of differentiation to calculate the differentials of trigonometric functions	Discuss with pupils the three basic trigonometric ratios $(\sin x . \cos x \ and \ \tan x)$ with their corresponding reciprocals $(\csc x . \sec x \ and \ \cot x)$ using the right-triangle. Solve problems on Differentiating trigonometric ratios applying the techniques of differentiation.		Ask pupils to list the trigonometric ratios. Record their responses on the board. Ask pupils to find the differential coefficient of $y = \sin x$. Ask one or two pupils to try and solve it on the board.

and exponential functions	Differentiate composite trigonometric functions. Differentiate logarithmic functions. Such as $y = \log_e(2x-5)$	Solve problems on Differentiating logarithmic and exponential functions applying the techniques of differentiation.		
Applications of differentiation Increasing and decreasing functions Rates of change, velocity and acceleration, turning points (maximum and minimum) Points of inflexion Tangents and normal practical problems	Students will be able to: Describe an increasing and decreasing function. Apply differentiation to determine rates of change velocity and acceleration (maximum and minimum), tangents and normal practical problems	Teacher to discuss with the students meaning of rate of change, Velocity and acceleration, Turning points (maximum and minimum). Explain that at a turning point $\frac{dy}{dx} = 0$. Solve problems as work examples on some application of differentiation.		Ask pupils to explain velocity and acceleration. Give pupils some class work for them to try. Find the maxima and minima points of the function$y = (2x-1)(4-x)^2$.
Integration Process of Integration The general solution of Indefinite integral. Definite integral	Students will be able to: define integration as the reverse of differentiation Determine the integrals of the form x^n and ax^n. Where n is a fractional, zero, or positive or negative integer $\int x^n\,dx = \frac{x^{n+1}}{n+1} + c$ (indefinite integral) $[x]_a^b = (b) - (a)$ (definiteintegral)	Explain to pupils the meaning of integration and he notation for integration as $\int$ Solve problems on indefinite integrals $\int x^n\,dx = \frac{x^{n+1}}{n+1} + c$. C is the arbitrary constant also known as the constant of integration. Explain the concept of definite integral$[x]_a^b = (b) - (a)$. Solve some mathematical problems on the definite and indefinite integrals.		Ask pupils to give the difference between differentiation and integration Give pupils (groups) exercises to try in class. E.g. integrate x^2 E.g. find $\int_1^2 (3x-4)\,dx$
Techniques of integration	Students will be able to:	Ask pupils to state the basic trigonometric ratios.		Integrate $\sin x$ and $\cos x$.

Introduction to integration of Trigonometric Functions. Integration by substitution Integration of Logarithmic functions Integration of exponential functions.	Integrate simple trigonometric functions $\int \sin x\, dx$. Integrate functions by substitution method Integrate logarithmic functions ($\int \ln x\, dx$) Integrate exponential functions ($\int e^x\, dx$)	Explain and guide pupils to integrate trigonometric functions. Discuss with pupils the process of substitution in integration. Explain how to integrate logarithmic and exponential functions.		Eg. Find $\int \frac{1}{2x} dx$.
Some applications of integration Area under curves Numerical integration	Students will be able to: Apply integration to calculate areas under curves Apply the trapezoidal rule to evaluate the area under a curve	Discuss the concept of definite integral to find the area $\left(\int_a^b f(x)\,dx \text{ or } \int_a^b y\,dx\right)$ and the volume of a solid obtained by rotating the area bounded by the curve $\left(V = \pi \int_a^b (f(x))^2\,dx\right)$ Explain the use of trapezium rule. Solve problems on the applications.		Give class work to pupils whilst you walk around supervising. E.g. Find the area bounded by the curve $y = 4x^2$, the x-axis and the ordinates x=0 and x=1
		YEAR 2/TERM 2		
Statics Resultant and resolving forces into components Equilibrium of coplanar forces Types of forces (weight, tension and trust)	Students will be able to: Explain the meaning of statics Resolve forces and calculate the resultant force Solve problems on the equilibrium of coplanar forces	Discuss the meaning of statics. Explain the resultant of forces and help students to resolve a force into components forces and compute the resultant force. $R = \sqrt{X^2 + Y^2}$, where X = horizontal component Y = vertical component Explain coplanar forces and solve some problems		Organize them in group and give them class exercises Example. A force F acts on a particle at an angle of θ to the horizontal. Find the horizontal and vertical components of F when F = 20N and $\theta = 20^0$.

Friction and coefficient of friction	Explain friction and resolve a contact force into normal and frictional components	Discuss friction and demonstrate the resolution of the normal and friction components Use the relation $F = \mu R$ to solve friction related problems		Ask students to explain the types of forces.
		YEAR 2/TERM 3		
Kinematics of a particle Speed, time distance velocity and acceleration.	Students will be able to: Define kinematics and other related terminologies and state their unit of measurement. Derive the equations of linear motion with uniform acceleration Solve problems on acceleration due to gravity Solve uniform accelerated motion problems graphically	Explain terminologies on uniform motion *(displacement, velocity, acceleration, distance, speed)* Apply the definitions of the terminologies to derive the equations of uniformly accelerated motion. That is $a = \frac{v-u}{t}$ $v^2 = u^2 + 2as.$ $s = \left(\frac{u+v}{2}\right)t.$ $s = ut + \frac{1}{2}at^2.$ Solve problems on uniform motion graphically Apply the concept of uniformly accelerated motion to solve problems on vertical motion.		Ask students to define speed, velocity, distance, displacement, and acceleration. Record their answers on the board. Group them and give work to do in class. Example. A particle is moving in a straight line with uniform acceleration. If it travels 120m while increasing speed from $5ms^{-1}$ *to* $25ms^{-1}$ find its acceleration. Conduct quizzes and tests
Dynamics Moment of inertia of a particle and rigid body Newton's laws of motion	Students will be able to: Define a rigid body State and explain Newton's laws of motion Solve problems using Newton's laws of motion	Define and explain rigid body Explain that moment of inertia of rigid body = sum of moments of inertia all the particles present in the body, ie $I = m_1 {r^2}_1 + m_2 {r^2}_2 + + \cdots$.. $\rightarrow I = \sum mr^2.$		Ask students to state and explain the laws of motion Organize students in groups and administer task to do. Example.

Motion of two connected particles Momentum and impulse Sum of moments Equilibrium of a lamina under parallel forces	Explain the meanings of momentum and impulse and how they are related Solve problems on conservation of linear momentum	Discuss Newton's laws of motion with practical examples Establish the relationship between impulse and momentum. That is impulse = change momentum, $I = m(v - u)$ Explain the principle of conservation of momentum. i.e. total momentum before impact = total momentum after impact or $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$		Find the resultant force which will produce an acceleration of $5ms^{-2}$ for a particle of 6kg. Example A car of mass 800kg decelerates from 20ms^{-1} to 5ms^{-1}. Find the loss of momentum.
YEAR 3/TERM 1				
Vectors Vectors and scalars Properties of vectors (representing vectors, equal vectors, null or zero vector) The magnitude and direction of a vector Algebra of vectors Triangle law of vector addition	Students will be able to: Describe vector and scalar quantities Write the notations for a vector and represent a vector on the rectangular Cartesian co-ordinate system. Compute the magnitude and direction a vector Apply the algebra of vectors including:(addition, subtraction and scalar multiplication of vectors) Use the geometric applications of vectors on the triangle	Explain vectors and scalars quantities with given examples to each Demonstrate the representation of vectors on a Cartesian plane using the graph Discusses the various ways of notating a vector. Eg $\overrightarrow{AB}$ (directed line segment joining two points from A to B) or as components of a point that is $\binom{x}{y}$. Bold type letter is another way of notating a vector. Calculate the magnitude as $\lvert\overrightarrow{AB}\rvert = \sqrt{X^2 + Y^2}$ and the direction as $\theta = \tan^{-1}\left(\frac{Y}{X}\right)$ Discuss the geometric approach to solve vector problems using the triangle law of vector addition.		Ask students to give examples of vector and scalar quantities. Record all responses on the board Ask them to represent a vector on the board Give them group work. Example. A girl walks xkm due east then zkm north-east. Calculate the total distance she has walked and her displacement from her starting point when $x = 3\ and\ z = 4$

	the parallelogram and other polygons Use the laws of addition and subtraction of vectors			
YEAR 3/TERM 2				
Matrices Operations on matrices Finding the determinant and Inverse of a matrix (limited to 2 x 2 matrices) Application of matrices (Cramer's rule) to solve simultaneous linear equations in two variables	Students will be able to: Explain what matrix is and their applications. Identify the order of a matrix and the types of matrices. Perform addition, subtraction, scalar multiplication and multiplication of matrices. Solve problems involving – Transposition of Matrices – Determinant of a(2x2) Matrix. -Inverse of a (2x2) matrix -Equality of Matrices	Teacher Modelling Explain matrices and their applications Types of matrices eg Row Matrix, column matrix, null matrix, square matrix, diagonal matrix, unit or Identity matrix. Model addition, subtraction scalar multiplication and multiplication of matrices. Model the use of simultaneous equations to solve problems involving equality of matrices.	Teacher Handbook Examples of large data that can be stored in a form of a matrix.	Standard Question on Matrices Probing Questions: If the determinant of a matrix is zero, what does that tell you about the matrix. What is the determinant of a singular matrix? When a matrix is multiplied by its determinant, the result is the Unit of Matrix. True or False? Convince me.

Resources
Measuring tapes
Metre sticks
Trundle wheels to measure long distances
Masses (1kg, 2kg etc)
Stop watches
Vanguards
Permanent markers (different colours)
Classroom displays
Class sets of rulers, protractors, compasses and pencils

Glue sticks
Sets of Geometrical models (3-D shapes)
Blue tac (to support classroom displays/charts)
Board Rulers, Protractors and compasses.
Interactive whiteboards
Playing cards
Spinners (for probability)
Tape Measures
Meter Rule
Height Measures
Weights
Callipers
2D Shape sets
Assorted coloured Dice
Vanguard Coloured Cards
Scale
3D Translucent Shapes
Strings and Threads