The New Senior Secondary Curriculum for Sierra Leone

Subject syllabus for Fundamental of Mathematics
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 Fundamental of Mathematics

Subject Description

Mathematics is the study of how we manipulate numbers and symbols to deal with quantities, space, shapes, and change. It is a subject that helps us understand and demonstrate relationships, order, structure, configurations, generalizations, and abstractions as we encounter and observe different aspects of our daily lives and our thoughts and imaginations. It evolved from basic activities of counting and measuring objects and describing shapes to now include abstract ways of using numbers and symbols to study changes in quantities and sets. Different branches of Mathematics include Arithmetic, Algebra, Geometry, Calculus and Statistics. When Mathematics is used independently in its abstract form to understand and predict different phenomenon, it is referred to as pure mathematics. When it is used to address real-life problems under various disciplines (e.g. Engineering), it is called applied mathematics.

Rationale for Introduction of fundamentals of Mathematics in the Senior Secondary School Curriculum

Fundamentals of Mathematics in the Senior Secondary School curriculum builds on learning at the JSS level. This course provides a solid understanding of the fundamentals of mathematics that are essential for individual progress and success as well as national progress towards the objective of mathematically competent and skilled Sierra Leonean youth. The course is intended to equip students with basic tools for understanding and contributing towards positive change(s) in the world. Such tools include skilled command over transferrable skills like logical reasoning, problem-solving, data analysis, organization, critical thinking, time management, decision making, and communications which student can continue to utilize in different academic and professional fields. Finally, it promises excitement for learners about discovering and understanding different mathematical concepts.

General Learning Outcomes [Broad Goals]

The general aim of this course is to enable students to:

- Appreciate and enjoy the benefits of using mathematics fundamentals in various areas.
- Improve their chances of becoming critical thinkers, problem solvers and independent thinkers.
- Develop improved communication skills through the practice of expressing ideas with mathematical precision.
- Improve learning in general through the use of logical thinking, analytical skills, and problem-solving approaches.
- Contribute to society with financial capability, enterprise/entrepreneurship, workplace competence and real life problem-solving skills.

Broad Structure & Sequence of Content for Fundamentals of Mathematics

	SSS 1	SSS 2	SSS 3
Term 1	• Integers • Fractions, Decimals and Percentages • Ratio, Proportion and Rates • Powers and Roots • Indices • Standard Form	• Surds [Radicals] • Approximation/Estimation • Set Theory • Representation: Pictogram, Bar charts, Pie charts • Grouping data • Estimate Mean from group data • Cumulative Frequency graphs • Deciles and Percentiles	• Logarithm • Logical reasoning • Variance and standard deviation • Angles of elevation/depression • Bearings • Circle Theorems • Calculus
Term 2	• Algebraic Expressions • Algebraic Manipulation • Equations – Linear, Quadratic, Simultaneous • Number Bases • Equations and Formulae [change of subject] • Undefined Algebraic fractions	• Graphs of Linear and Quadratic functions. • Manipulating Algebraic Fractions • Linear inequalities/Linear Programming and Quadratic Inequalities. • Relations, Mapping • Sequence and Series • Matrices and Determinants	• Area of sector and length of arc • Similarities • Transformation • Graphs of Trigonometric functions • Trigonometric Ratios • Vectors
Term 3	Statistics Definition of Data and types of Data Statistical Measures • Averages and their advantages & disadvantages • Probability • Language of Probability • Probability Scale • Probability of events happening • Theoretical Probability/Experimental Probability • Mutually exclusive events • Expected Frequency	Shape, Space Measure • Angles, Line and Triangles • Polygons and Congruency • Lines of Symmetry and rotational symmetry • Construction • Loci • Circles • Mensuration of 2D objects • 3D shapes and Volumes • Pythagoras' Theorem • Trigonometry in right angle triangle and non-right	

Teaching Syllabus

Topic/Theme/Unit	Expected learning outcomes	Recommended teaching methods	Suggested resources	Assessment of learning outcomes
Year 1/Term 1				
Numbers and the Number System INTEGERS	**Students will be able to:** Explain and use integers Explain Place Value Explain 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 Modelling and explanations. Examples: Find ⅔ of 180 = ⅔ x 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 number 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.	Teacher Modelling: $0.65 = \frac{65}{100} = \frac{13}{20}$ Change 0.3 to a fraction in its simplest form. Let Fraction = F		Explain to me which fractions or percentages you can easily work out in your head.

	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. Explain that 'percentage' means 'number of parts out of 100'. 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.	F=0.3333 [multiply by 10] 10F = 3.3333 9F = 3 F = 3 = ⅓ 9 .. Convert 0.13 to a fraction. Let Fraction = F F = 0.131313…… multiply by 100 100 F = 13.131313…… [Subtract] 99F = 13 F = 13 99 . Convert 0.23 to a fraction Let F = 0.23333…. Multiply by 10 .10F = 2.3333…… ignore the first equation 100F = 23.333 ….. multiply this new equation by 90F =21 10 and subtract F= 21 90 F = 7 30 **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 120 = 1.2 100 This is called the multiplier.		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. 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.

	Calculate depreciation. Explain and do calculations involving hire purchase and percentage error. Calculate repeated percentage changes.	. when a quantity is increased by 15%, the new quantity becomes 115% [100+15] of the original quantity. 115% means 115 = 1.15. This is the 100 multiplier. Similarly, when a quantity is reduced by 150%, The new quantity is 85% [100 – 15] of the original amount. 85% This means 85 = 0.85. 100 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 = 140 000 0.7 N = Le200,000.00 Example Fatima invests Le300,000.00 in a bank at 4% Compound Interest. Calculate the total amount after a period of 3 years. Solution 4% Interest means multiplier is [100 +4] 104% which is equal to 1.04. Compound Interest means this is applied each year. So 1st year = 3000000 x 1.04 2nd year =[3000000x1.04]x1.04 3rd "=3000000x1.04x1.04]x1.04 This is neatly written as 300,000 x 1.04^3 = Le 337,459.20		How do you know that a fraction will produce recurring or terminating decimal? Which of the following statements 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. A store gives a 20% discounts 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 Rates	**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. Calculate rates of work, foreign exchange, density [including population density, speed, distance and time.	Teacher Modelling 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
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?
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? $48 \times 56 = 3 \times 7 \times 2^c$ What does the index of ½ represent?
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?
Year 1/Term 2				
Algebra **Algebraic Expressions** **-**collecting terms -Expansion -Factorization	**Students will be able to:** Collect like terms Expand single brackets. Expand double brackets Factories algebraic expressions by Linear factorization, Difference of 2 squares, Quadratic factorisation, Group factorisation Solve word problems in context.	Teacher Modelling When modelling, explain to students that factorization 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: (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. Get pupils to clearly write down their rules and how they got their answers. Get pupils to do presentation to the class. -clarify misunderstandings and misconceptions.	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 expressions? 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
Algebraic Manipulation	**Students will be able to:** Manipulate algebraic fractions with the numerator and/or the denominator being a numeric, linear or quadratic. Express a quadratic expression in completed square form	Teacher Modelling E.g. write as a single fraction; $\frac{3x + 1}{X + 2} - \frac{x - 2}{x - 1}$ Simplify: $\frac{2x^2 + 3x}{4x^2 - 9}$ Example Write $2x^2 + 6x - 1$ in the form $a(x + b)^2 + C$	Teacher Handbook	Answer standard questions on algebraic Manipulation
Equations • Linear • Quadratic Simultaneous	**Students will be able to:** Solve Linear equations including equations with brackets, equations with the unknown on both sides of the equals to sign, and equations with fractions. Construct and solve Linear Equations from Word problems and in context. Solve equations involving algebraic fractions Example Solve: $\frac{1}{X} + \frac{1}{2x+1} = \frac{7}{10}$	Teacher Modelling of various types of Linear equations Examples [i] solve 3(x + 2) = 4 [Expand] 3x + 6 = 4 subtract 6 from both sides 3x = -2 Divide by 3 on both sides. X = -⅔ [ii] ⅓(X + 2) = ⅖ (x – 10) simplify To get rid of fractions, multiply by the LCM of the denominators which is 15. 15 x ⅓(x + 2) = 15 x ⅖(x-10)	Teacher Handbook	Standard questions on Linear Equations including from Exam Board past papers. **Probing Questions** Here is a list of given equations. -Which one of these are easy to solve? -Which ones are difficult and why? -What strategies are important with the difficult ones? The length of a rectangle is three times its width. Its

		5(X + 2) = 6(X – 10) Expand 5X + 10 = 6x – 60 Subtract 5x from both sides 10 = x – 60 Add 60 to both sides 70 = X X = 70 The cover method could also be used for simple examples.		perimeter is 24cm. Find its area. In an ice cream shop, a large cone of ice cream costs 40p more than the small cone. The cost of 2 large cones is the same as 3 small cones. Find the cost of a large ice cream cone. Find the cost of the small ice cream cone. How do you go about constructing equations from information given in a problem? How do you check whether the equations work?
Quadratic Equations	**Students will be able to:** Solve Quadratic equations using the following methods: Factorisation method; Completing the square method; Formula method; Forming quadratic Equations with given roots.	Teacher Modelling: Example Solve by factorising $X^2 – 8x + 12 = 0$ First factorise $x^2 - 8x + 12$ (X – 6)(x-2)=0 This means that both or one of the brackets must be equal to zero because their product is zero. So X – 6 = 0 X=6 x-2 =0 x=2 So two answer x = 6 and x = 2	Teacher Handbook	Students to answer standard questions in solving Quadratic equations including from Exam Board past papers. **Probing Questions** What clues would you be looking for to warn you that a given quadratic equation cannot be solved by factorisation? How would you apply the technique of completing the squares to a quadratic

				equation with coefficient of x^2 greater than 1.
Simultaneous Equations	**Students will be able to:** Solve Linear simultaneous equations Solve 1 Linear and 1 quadratic equation. Solve simultaneous equations from word problems.	Teacher Modelling Model the solving of two Linear simultaneous equations by method of elimination and method of substitution. Also model solving of 1 Linear and 1 Quadratic by substitution method. Example: $2x + 3y = 17$, $3x-5y = 35$ Example: $y = 2x – 3$ and $y = x^2 – 4x +5$ Example $y = x^2 + x + 3$ and $2x + y=1$ Solve by completing the square to 2d.p $X^2 – 2x – 10 =0$ First eliminate the constant from the left-hand side by adding 10 to both sides. $X – 2x = 10$ Take the coefficient of x → -2 halve it → -1 square the answer → +1 Add this to both sides of the equation above $X^2 – 2x + 1=10+1$ $X^2 - 2x + 1$ is said to be a perfect square which factorising to $(x-1)^2$ So substituting $(x-1)^2 = 11$ $X – 1 = \pm\sqrt{11}$ $X = 1 \pm \sqrt{11}$ = ……. $X = 1 - \sqrt{11}$ = …….. Solve $2x^2 – 8x + 5 = 0$	Teacher Handbook	Students answer standard question simultaneous equations. **Probing Questions** How would you know that a problem given will need to be solved using simultaneous equations? What is confusing when using the elimination method to solve simultaneous equation? What is confusing when using substitution method to solve simultaneous equations. Can you think of a better strategy to avoid such confusions? A cycle shop has a total of 36 bikes [okada] and tricycles [Kekeh] in stock. Altogether there are 80 wheels. How many bikes [okada] and how many Tricycles [kekeh] are there?

		Using the quadratic formula to 2 decimal places. Substitute a=2, B= - 8 and c = 5 into the quadratic formula.		
Number bases	**Students will be able to:** Explain the concept of number bases in counting systems. Convert numbers from one base to another. Perform basic operations on number bases. Solving equations involving 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 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?
Equations and Formulae Change of subject Substitution into formulae	**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. Evaluate a letter by substituting into a formula	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 $V=\frac{4}{}\pi r^3$	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?

	given the values of other letters.	Make L the subject of $T = 2\pi \sqrt{L/G}$ 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.		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?
Undefined Fractions	**Students will be able to:** Explain that an undefined fraction is a fraction with denominator equal to zero. Solve problems on undefined fractions	Teacher Modelling Examples For what value of x is the fraction $\frac{3x+2}{x+4}$ undefined? Solution X+4 = 0 X=-4 For what Value[s] of x is the fraction $\frac{3x^2-4}{x^2-16}$ Undefined? Solution $X^2-16=0$ $X^2=16$ $X=\pm\sqrt{16}$	Teacher Handbook	Students answer standard questions on undefined fractions.

		X=4 or -4 Or use the difference of 2 squares approach.		
		Year 1/Term 3		
Definition of data and types of data Primary/Secondary data, Categorical/Numerical data, Discrete/Continuous data.	**Students will be able to:** Define data in their own words. Distinguish between Primary and Secondary data. Distinguish between categorical data and numerical data Students should know that numerical data can be discrete or continuous and understand the usage of these words.	Open question to the class: "What is data?" Record pupils' responses on the board with probing questions to clarify misconceptions and collectively answer question 'What is data?' Teacher Modelling for primary/secondary data, categorical/numerical data, and Discrete/Continuous data Display keywords around classroom (and corridor)	Display of different types of data. Measuring instruments: Ruler, Tape measures cards/vanguard. Teacher's Handbook	Students are asked to group given data into categorical or numerical and discrete or continuous using matching cards. Students to work in pairs or in groups to look around the classroom or local environment and produce: 5 real-life examples each of categorical and numerical data. 5 real-life examples each of measurements that will produce discrete and continuous data.
Statistical Measures Concept of average for data in form of a list or a Frequency Table. Mean, Median, Mode and Range for discrete data set. Know the advantages and disadvantages of	**Students will be able to:** Calculate mean, median, mode and range for discrete data set. Examine data and identify extreme values [outliers]. Explain the advantages and disadvantages of using Mean, Median and Mode.	Pre-lesson activity Select seven volunteers to come to the front of the class. Get the students to arrange themselves in ascending order of their heights. [from left to right facing the class] Explain to class that the student in the middle is said to have the Median height. The student on the far left has the lowest height and the student on the far right has the highest height. Explain that heights range from the shortest to the tallest and the range can be calculated		Standard questions on Mean, Median, Mode and Mode. **Problem solving**: Find a set of five positive whole numbers with: Range 10 Mode 4 Median 6 Mean 7 Is there more than one possible set?

using Mean, Median and Mode.		by subtracting the smallest height from the largest height. Repeat this exercise for even number of students e.g 10 students. Ask students if they notice anything different about the Median. Accept different responses e.g. there are 2 students - It is between the 2 students. -Discuss with students the best way of resolving the Median height. Ie Adding the 2 middle heights and dividing by 2. Get students into small groups. Give each group sets of numbers to arrange in order of size. Some sets of numbers should contain extremely high and low values. Students to discuss in their groups and talk about possible outliers and the Median. Model with whole group: calculation of Mean, Median, Mode and Range. Students answer standard question on Mean, Median, Mode and Range. Summarise advantages and disadvantages of Mean, Median and Mode.		Repeat for a set of six numbers. Find as many possible answers as you can. **PROBING QUESTIONS** Is the Median the most appropriate average to calculate for this data set? Convince me. Convince me that the Mean is the most appropriate average to calculate for this data set. Convince me that the Mode is the most appropriate average to calculate for this data set.

Year 2 Term 1				
Surds [Radicals]	**Students to be able to:** Add and subtract Surds. Multiply and divide surds. Expand and simplify Surds. Rationalise denominators [including binomial denominators]	Teacher Modelling Model standard questions on surds. Surds of the form $\frac{a}{\sqrt{b}}$, $a\sqrt{b}$, and $a \pm \sqrt{b}$ Where a is rational and b is a positive integer	Teacher Handbook	Standard questions on Surds.
Approximation and Estimation	**Students will be able to:** Round numbers toa 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 are rounding to decimal places and significant figures. Questions on upper and lower bounds.
Set Theory	**Students will be able to:** Explain what a set is Differentiate between 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	Answer standard questions on set theory from Examination Board past papers.
Representation of data using:	**Students will be able to:** Recognise, construct and interpret pictograms, bar	Display various charts as seen in real life situations E.g. newspapers [Awoko business], adverts, magazines, websites.	Newspapers, reports, advertisement, magazines.	Students are given secondary data and asked to construct appropriate charts.

-pictogram, bar charts, Pie charts, -use appropriate methods of tabulation to enable the construct of statistical diagrams. -interpret statistical diagrams.	charts, [vertical, horizontal and composite] and pie chart. Use ICT [Spreadsheet] to design charts.	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.	-compasses and rulers -secondary data	**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?
Grouping Data Construct grouped frequency table with equal class interval. Identify the modal class interval from grouped frequency table Frequency diagram from group discrete data Histograms from grouped continuous data. Frequency Polygons.	**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. Construct and interpret Histograms from grouped continuous data Construct frequency polygons and compare two or more sets of data using super imposed frequency polygons.	Display the various charts as seen from real life examples from Newspapers, Adverts, Text books 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. Pupils construct their own diagrams. Pupils work put on display.	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? -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	**Students will be able to:**	Review prior knowledge from SSSI on Mean, Median, Mode and Range from a list. Also review Mean from Frequency Table .		Students answer standard questions.

-Estimating Mean from grouped data, -Identify modal class for grouped data and the class interval that contains the median.	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 – 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.		**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.
		Year 2/Term 2		
Graphs of Linear and Quadratic functions	**Students will be able to:** Recall prior knowledge on Linear graphs Example Equation of a straight line in the form y= mx + c with m being the gradient and c the intercept of the line on the y-axis. Calculate gradient of line by drawing triangles or using two points on the line. Gradient formula =change in y / Change in x Show that when lines are parallel their gradients are the same. Show that when lines are perpendicular the product of their gradient equals -1. Find the distance between two points on a line.	Teacher modelling Examples Find the equation of a live parallel to Y=3x + 2 and going through (0,6). Model the concept of gradient of a line and how the equation of the line can be determined by looking at the equation.	Teacher Handbook Graph Paper Auto graph software	Standard Questions on Linear graphs and their equations **Probing Questions** State the gradient of the graphs with the equations Y=3x + 1 Y = 7 – 2x 2x + 3y = 6 A linear graph has equation y=mx + c If you increase the value of M, what changes would you expect to see on the graph? If you make m = 0 what changes will you see on the graph. Without drawing, compare and contrast features of the following pairs of graphs. [i] y=3x and y=3x+4 [ii] y=x+4 and y= x-2 [iii] y=3x-2 and y= -3x+4 [iv] 3x+4y =12 and 5x+3y = 15

	Find the midpoint of a line joining two points.			
Quadratic Graphs	**Students will be able to:** Fill table of Values, plot co-ordinates and draw graphs of quadratic functions. Obtain roots of the function from the graph. [These roots to be linked to the values of x, if this function was to be solved algebraically] Find the Co-ordinates of the maximum and minimum points on the graph. Locate and state equation of line of symmetry of the curve. Solve related equations using quadratic graphs. Determine the gradient at a point on the curve by drawing Tangents [and using Calculus] Investigate the behaviour of the curve when the coefficient of x^2 changes from a positive Integer, through zero and to a negative Integer.	Teacher Modelling and investigative work. Get students to investigate the behaviour of the curve when the coefficient of x^2 is changed from say 3 to 2, to 1, to 0, to -1, to -2, and -3. This can be done using autograph or actually drawing on graph paper. Get students to discuss their findings and draw conclusions.	Teacher Handbook Graph paper Autograph software	Students answer standard questions on Quadratic graphs including questions from past Examination Board papers. **Probing Questions** By inspecting a quadratic function, how can you tell it has got a maximum or minimum turning point? How would you compare the gradient of a straight line and the gradient of a curve.

Manipulating 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 [iii] $\frac{3x^2 + 9x}{X^2 + 4x + 3}$ [iv] $\frac{x^2 + 3x - 4}{X^2 + x - 2}$	Teacher Handbook	Students answer standard questions on algebraic fractions.
Linear Inequalities [Linear Programming]	**Students will be able to:** Explain Inequality 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 Mappings Functions and Function notations	**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	Teacher Modelling Explain sequence Explain series	Teacher Handbook Multilink Cubes	Students answer standard Question on A.P and G.P including those from past

	and be familiar with the language and symbols of sequences. Identify sequences of odd numbers, 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.	Matchsticks Counters Matchboxes	Exam Board question papers. **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?
Matrices and determinants	**Students will be able to:** Explain a matrix and their applications. Identify the order of a matrix and the types of matrices. Perform addition, subtraction, scalar multiplication and multiplication 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

	Solve problems involving: Transposition of Matrices; Determinant of a(2x2) Matrix; Inverse of a (2x2) matrix; Equality of Matrices			determinant, the result is the Unit of Matrix. True or False? Convince me.
Year 2/Term 3				
SHAPE, SPACE AND MEASURES Angles, Lines and Triangles	**Students to be able to:** Distinguish between acute obtuse reflex Draw and measure angles and right angles. Use angles related to intersecting lines and parallel lines. Show the exterior angle of a triangle property and the sum angle of a triangle property. Explain the terms 'Isosceles', equilateral , 'Scalene' and right-angled triangles' and their related properties.	Teacher Modelling -Angles around a point -Vertically opposite angles -Alternate angles -Corresponding angles -Interior [allied] angles Teacher to identify local resources as examples of the different triangles. Students to physically draw several angles and measure using protractor.	Teacher Handbook Protractors	Students answer standard questions on angles and parallel lines. Students to draw their angles and measure using protractor as students to also draw given angles.
Polygons and Congruency	**Students will be able to:** Recognise and give the names of polygons. Explain the angle sum of a quadrilateral, name all quadrilaterals and state their properties.	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	Teacher Handbook	Students to answer standard questions. **Probing Questions** Describe a rectangle precisely in words so that someone else can draw it.

Identify a regular polygon 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 = $\frac{360}{\text{No of sides}}$

Explain the meaning of congruent shapes

No of sides	Name	Triangles	Sum of angles
3	Triangle	1	180
4	Quadrilateral	2	2 x $180=360^0$
5	Pentagon	3	$3x180=540^0$
6			
7			
8			
N			

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

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.
-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, 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
Construction	**Students will be able to:** Construct angles bisectors and bisectors of line segment. Construct a perpendicular from a point to a line. Construct a perpendicular from a point on a line. Construct a line parallel to another line. Construct angles 90^0,60^0, $45^0$and 30^0 Construct triangles and quadrilateral based on given information.	Teacher Modelling -Model the whole of construction to include angles 75^0, 105^0, and 135^0	Teacher Handbook Compasses and rulers.	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? 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
LOCI	**Students will be able to:**	Teacher Modelling Make connection between Loci and Construction.	Compass Pencils	Students to answer standard questions on Loci

<table>
<tr>
<td></td>
<td>Construct points at a given distance from a given point [a circle]

Construct points equidistant from 2 given points [bisector of a line]

Construct points equidistant from 2 given lines [Angle bisector]

Construct points at a given distance from a given line [Line parallel to another line]

Apply Loci to real life situations.</td>
<td>Example: A perpendicular bisector of a line AB is the Loci of points equivalent from A and B</td>
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<tr>
<td>CIRCLES</td>
<td>Students will be able to:

Identify parts of a circle. Eg centre, radius, diameter, circumference, tangent, arc, sector, segment, chord segment,

Calculate Area and Circumference of a circle, including Compound shapes and semi circles.

Investigate the relationship between the Circumference and diameter for various circles and obtain a Value for 'pi'.</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><th>Circumference</th><th>Diameter</th><th>Circumference ÷Diameter</th></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 to divide the circumference by the diameter. What conclusions can they draw. This value is an estimate of the Constant Pi.		
Mensuration of 2D shapes	**Students will be able to:** Convert measurements within the metric system including Linear and area units. Find the area and triangles and rectangles including compound shapes. Find the 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. Eg 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.
3D Shapes and Volume	**Students to be able to:** Recognise and name 3D solids Correctly use the terms 'face' 'edge'' and 'vertex'	Teacher Modelling 3D shapes to be displayed to include cube, cuboid. Prisms, pyramid, cylinder, sphere, hemisphere, cone, frustum.	Teacher Handbook 3D sets of models including solids collected from the local environment.	Standard questions on 3D shapes and volumes.

	in the context of 3D solids. Distinguish between Prism and non Prisms [ie 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. Explain total surface area and calculate total surface area of 3D shapes Convert between units of volume within the metric system ie $cm^3$to $m^3$and vice versa. I Litre = $1000cm^3$			
Pythagoras theorem **Trigonometry in right angle and non-right-angle triangle**	**Students to 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

Year 3/Term 1				
Logarithm [Exclude use of logarithm tables]	**Students be able to:** Relate indices to logarithm Apply the laws of logarithm to solve problems. Apply the proportions of logarithm to solve problems. Solve equations involving logarithms	Teacher Modelling Model logarithm including its relation to indices, the laws of logarithm and the properties of logarithm.	Teacher Handbook	Students to answer standard questions on Logarithm including those from Exam Board past papers.
LOGICAL REASONING	**Students to 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.

Variance and Standard Deviation	Students will be avble to: Describe Variance as a measure of spread that uses all the data, unlike the interquartile range that uses two values, the upper and lower quartile. Describe 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 will you apply the Interquartile range to and which ones you will apply the variance to.
Angles of Elevation and 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. -students can work outdoors using clinometers or improvised clinometers using protractors and paper tubes.	Clinometer Improvised Clinometers	Students to answer standard questions on angles of elevation and depression.
Bearings	**Students will be able to:** Explain 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 Eg Trundle wheel Tape Measures	Students answer standard question on bearings.

Circle Theorems	**Students will be able to:** Use the circle theorems and 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.
CALCULUS Differentiation	**Students will be able to:** Explain the concept of a variable rate of change. Differentiate Integer powers of x. Determine gradient stationary points, turning points [maxima and minima] by differentiation and relate to calculating gradient of curve at a given point.	Teacher Modelling When modelling gradient of a curve at a point, first get students to estimate gradient of curve at the stated point by drawing a tangent at that point and then find the gradient of the Tangent. Include finding co-ordinates of turning points.	Teacher Handbook	Standard questions on differentiation. **Probing Questions** Why When Finding The gradient of a curve at a point, drawing a tangent is not a good method?
		Year 3/Term 2		
Area of Sectors and length of arc	**Students to be able to:** Calculate area of sector and length of arc by use of formulae.	Teacher Modelling Use circular filter paper to cut out sector for demonstration purpose	Teacher Handbook Circular filter paper	

	Calculate area of segment using area of triangle =½abSin C Explain that when a sector in folded, it forms a cone and appreciate the relationship between - the area of the sector and the curved surface area of the cone. - the radius of the arc and the slant edge of the cone. Explain the relationship between the length of the arc and the circumference of the base circle of the cone which it makes when folded.	Model questions on calculating area of segment. Area of segment = Area of sector – Area of Triangle		
Similarity Finding surface area and volume of similar figures	Students to understand that shapes are similar when one is an enlargement of the other and that corresponding sides and angles are all in the same ratio. Students to be able to 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.

	Students to be able to calculate length, area and volume of similar figures **Students to be able to use similarity to calculate volume of frustum.**			
Transformation Reflection Rotation Translation Enlargement	**Students to be able to:** [i] reflect 2D shapes on graph paper given the equation of the line of reflection. [ii] rotate a shape on graph paper giving the centre of rotation and the angle and direction of rotation. [iii]Translate a shape on graph paper given the Vector Translation. [iv] Enlarge a shape given the centre of rotation and the scale factor. [v] students to 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 is clockwise rotation and use tracing paper to rotate the shape accordingly around the centre of rotation. When modelling transformation explain the column vector Notation. [$^{x}_{y}$] E.g when asked to translate a shape by vectors [$^{3}_{2}$] It means move the shape 3 steps to the right along the x-axis and then 2 steps upwards along the y-axis.	Teacher Handbook Graph Paper Mirrors Tracing paper	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? A reflection in one axis followed by a reflection in the other axis is the same as a rotation.

		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.		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?
Graphs of Trigonometric functions. **Y = Sin x** **Y = Cos x**	Students to recognise the shapes and draw simple graphs of y = Sin x, y=COS x and Cos solve simple equations. Students to 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 graphs 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
Trigonometric Ratios	Students to 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?
Vectors	**Students will be able to:**	Teacher Modelling	Teacher Handbook	Standard questions on Vectors, including

	Distinguish between scalar and vector quantities. Explain vector notation and representation. Explain that the negative or inverse of a vector. Add, subtract vectors and multiply vectors by a scalar. Calculate with position vectors. Identify parallel and perpendicular vectors.			questions from past exam board papers.
Probability -Understand the term 'Probability' -Language of probability -Probability scale -Probability of events happening	**Students will be able to:** Use simple language of probability [certain, impossible, likely, unlikely, even chance, impossible, outcomes, equally likely] Use probability scale. Calculate probability of events happening. Draw a sample space diagram for given events. Determine the probability of an event occurring	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. A sample space of all outcomes when two coins are spun together. Standard questions on probability including probability scale.	Coins Dice Counter	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'? The Probability of getting a '3' when a die is thrown is 1/6. Can you explain why?

	from a sample space diagram.			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 Explain the term 'mutually exclusive' and can find the probability of Mutually exclusive events. Use the fact that the sum of all mutually exclusive outcomes of an event is Use the addition rule of Probability for 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 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

	Calculate expected frequency			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 Use correctly the term "independent events" Use 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. A counter is picked at random, the colour noted and then replaced. This is done a second time. List out all possible 4 outcomes Ie: 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',	Teacher Handbook Counters	Students answer standard questions on Probability tree diagrams. **Probing Questions** -In a city, 80 people with Coronavirus symptons 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 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.

		'neither', 'with replacement', 'without replacement', 'at least', 'at most'. Also incorporate the Addition rule for probability when modelling solutions on probability.		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.

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
Multilink Cubes
Centimetre Squared Paper
Dotted Isometric Paper
Tracing paper
Clinometer [improvised clinometers]
Graph paper
Autograph software
Newspapers/magazines/leaflets
Mathematical instruments [compasses, rulers etc]
Car wheel covers
Car "badges"
Circular filter paper
Internet [Secondary data research]
Mirrors
Coins
Matchboxes
Matchsticks
Counters