

PURE OVERVIEW

Topic	Objectives	😊	😐	😞	Comments
TOPIC 1 PROOF	Proof by deduction				
	Proof by exhaustion				
	Disproof by counter examples				
	Proof by contradiction inc proof $\sqrt{2}$ is irrational and the infinity of primes				

TOPIC 2: ALGEBRA & FUNCTIONS	Rules of indices				
	Expanding and factorising				
	Simplifying and manipulating surds				
	Rationalising a denominator				
<i>Quadratic functions</i>	Solving by factorising				
	Completing the square – inc. co-efficient of $x^2 > 1$				
	Using the quadratic formula				
	Sketching the graphs of quadratics				
	Discriminant of a quadratic				
	Using quadratics to solve trig functions, exponential and log functions of x				
<i>Equations and Inequalities</i>	Solving simultaneous equations by elimination and by substitution				
	Simultaneous equations, one linear one quadratic				
	Inequalities; linear - solve algebraically and interpret graphically				
	Inequalities; quadratic - solve algebraically and interpret graphically				
	Express solutions through correct use of 'and' and 'or' or through set notation				
<i>Sketching curves and transformations</i>	Sketching a cubic function				
	Sketching a reciprocal function, $y=1/x$ and $y=1/x^2$				

	Finding points of intersection				
	Transformations of the form $f(x)+a$ and $f(x+a)$				
	Transformations of the form $af(x)$ and $f(ax)$ – including reflections				
	Understand the modulus function and sketch graphs of the form $y= f(x) $ and $y=f(x)$.				
	Solve modulus equations				
	Sketch graphs of transformations, including combinations of more than one transformation				
<i>Polynomials</i>	Use direct proportional relationships and their graphs				
	Manipulating polynomials				
	Simple algebraic division				
	The Factor Theorem				
	Factorisation of a cubic				
<i>Algebraic fractions</i>	Simplify algebraic fractions by cancelling common factors in numerator and denominator				
	Multiply and divide algebraic fractions and simplify the answer				
	Add or subtract algebraic fractions by finding a common denominator				
	Change algebraic improper fractions into mixed number form				
	Addition and subtraction of algebraic fractions				
	Partial fractions with linear factors				
	Partial fractions with repeated factors				
	Improper partial fractions				
<i>Functions</i>	Know the terms; mapping diagrams, domain, range and complete mappings				
	Understand the difference between one-to-one, many-to-one and non-functions and be able to state the range of and sketch a simple function				
	Combine two or more basic functions to make a new composite function				
	Know how to find the inverse of $f(x)$ and recognise that the graph of the inverse is a reflection of $y=f(x)$ in the line $y=x$				
<i>Context</i>	Use of functions in modelling, inc considering limitations and refining the model.				

TOPIC 3: COORDINATE GEOMETRY	Equation of a straight line in $y=mx+c$ or $ax+by+c=0$ form				
	Gradient of a straight line				
	Equation of a straight line in $y-y_1=m(x-x_1)$ form				
	Conditions for lines to be parallel or perpendicular				
	Geometric properties of the circle e.g. angle in semicircle, relationships with tangents, chords				
	Equation of the circle – including completing the square				
	Find equation of a circumcircle given vertices				
<i>Parametric equations</i>	Use of parametric equations in geometry				
	Converting from parametric to Cartesian form				
	Use parametric equations in modelling contexts				
	Find parametric equations for motion (kinematics in mechanics)				

TOPIC 4: SEQUENCES AND SERIES	n^{th} term of a sequence				
	Sequences formed by recurrence relations				
	Arithmetic sequences and series				
	Sum to n of an arithmetic series				
	Proof of the sum of the first n terms of arithmetic series				
	Sigma (Σ) notation				
	Increasing sequences, decreasing sequences and periodic sequences				
	General expression for n th term of a geometric sequence				
	Conditions for convergence and sum to infinity				
	Proof of the sum of the first n terms of a geometric series				
	Use logs to find value of n				
	Use of sequences in modelling				
	Use of Pascals triangle				
	Factorial and ${}^n C_r$ notation				

<i>Binomial expansion</i>	Expansion of $(a + bx)^n$ expressions			
	The general form of the binomial expansion and validity			
	Problems in the form $(a + bx)^n$ inc. finding approximations			
	Expanding partial fractions			

TOPIC 5: TRIGONOMETRY	Area of a triangle as $\frac{1}{2}absinC$			
	Sine and Cosine Rules			
	Graphs of sin/cos/tan including symmetry and periodicity			
	Use of x and y cords of points on the unit circle			
	Use of basic trigonometric identities			
	Solution of simple trig equations inc quadratics in $\sin x$ etc			
	Relationship between degrees and radians			
	Length of arc			
	Area of sector			
	Small angle approximations			
	Knowledge of the reciprocal functions secant, cosecant and cotangent including their graphs			
	Solving equations involving $\sec x$, $\operatorname{cosec} x$ and $\cot x$			
	Proving identities involving $\sec x$, $\operatorname{cosec} x$ and $\cot x$			
	Use of the three Pythagorean identities			
	Knowledge of the inverse trig functions and their graphs			
	Knowledge and use of the addition formulae			
	Knowledge, derivation and use of the double angle formulae			
	Using identities to solve equations			
	Using identities to prove identities			
	Reduction of the $a\cos\theta + b\sin\theta$ form using the addition formulae($R\cos(\theta-\alpha)$) and use of transformations with this			

TOPIC 6: EXPONENTIALS & LOGARITHMS	y = e ^x and its graph			
	Laws of logarithms			
	Solution of equations of the type a ^x = b			
	Know the graphs of y=a ^x and y=ln x.			
	Know that e ^x and ln x are inverse functions of each other			
	Manipulate exponentials and logarithms to solve equations and apply to models			
	Change of base formula			
	Realise that when rate of change is proportional to y value an exponential model should be used - Understand gradient of y = e ^x			
	Linearising log graphs to estimate unknown parameters			
	Use exponential and logs in modelling, consider limitations and refinements			

TOPIC 7: DIFFERENTIATION	The derivative f'(x) as the gradient of y = f(x)			
	Differentiation from first principles			
	Sketching the graph of gradient function			
	Finding the gradient function of ax ⁿ			
	Simplifying functions to enable differentiation by rule			
	Finding the second derivative			
	Finding the rate of change at a point			
	Finding the equation of a tangent or normal to a curve			
	Application to maxima, minima, stationary points, understand convex and concave, and points of inflection			
	Increasing and decreasing functions			
	Application to practical problems			
	Use of the chain rule			
	Use of the product rule			
Use of the quotient rule				

	Differentiating exponential and logarithmic functions				
	Differentiating trigonometric functions				
	Differentiating more complex functions using a combination of the above				
	Parametric differentiation				
	Implicit differentiation				
	Differentiation of $y = a^x$				
	Connected rates of change				
	Solving differential equations				

TOPIC 8: INTEGRATION	Integrating functions in the form ax^n				
	Integration as the reverse process of differentiation				
	Simplifying functions to enable integration by rule				
	Finding the constant of integration				
	Evaluation of definite integrals				
	Calculation of the area under a curve				
	Calculate the area between two curves				
	Recognise $\int_a^b f(x) dx = \lim_{\delta x \rightarrow 0} \sum_{x=a}^b f(x) \delta x$				
	Estimation of area by use of the trapezium rule				
	Integration of standard functions – the standard results				
	Using trigonometric identities				
	Using partial fractions				
	Integration by substitution				
	Integration by parts				
	Parametric integration				
Setting up and solving differential equations in context					

TOPIC 9: NUMERICAL METHODS	Sketch graphs and use the change of sign method to locate roots				
	Understand how change of sign can fail				
	Use iterative and algebraic methods to find approximate roots of $f(x)=0$				
	Be able to draw associated cobweb and staircase diagrams				
	Use recurrence relations $x_{n+1} = g(x_n)$				
	Know when these methods can fail				
	Solve equations with Newton Raphson method				
	Understand the working of NR and understand failure when $g'(x)$ is small				
	Determine whether trapezium rule gives an over or under estimate				
	Check that a root is correct using error bounds				

TOPIC 10: VECTORS	Use vectors in two dimensions, be familiar with i, j and column vectors				
	Use vectors in three dimensions, familiarity with i, j and k and column vectors				
	Calculate the magnitude of a vector				
	Convert between component form and magnitude/direction form				
	Find unit vector				
	Add vectors on a diagram and algebraically				
	Multiply vectors by scalars				
	Show vectors are parallel, use λ and μ				
	Understand position vectors				
	Find angles between a vector and a coordinate axis				
	Use vectors to solve problems in context				