Higher Course Plan

Applications **Calculus and Relationships** **Expressions and Functions**

Topic	Duration
1: The Straight Line Find the gradient of a line Collinearity Know the features of gradients of: • parallel lines • perpendicular lines Know the equation of a straight line of the form $y = mx + c$ Know an equation of a straight line of the form $ax + by + c = 0$ Know the equation of a straight line of the form $y - b = m(x - a)$ Find the distance between two points using the distance formula Recognise the term locus Find the equations of: • medians • altitudes • perpendicular bisector Know the concurrency properties (in triangles) of: • medians • altitudes • perpendicular bisectors	**June** **9 periods** 1. Gradient – revision and $m = \tan\theta$ (Ex 1A) 2. Collinearity (Ex 1B) 3. Perpendicular lines; $y = mx + c$; $Ax + By + C = 0$ (Ex 1D, 1E, 1F) 4. $y - b = m(x - a)$ (Ex 1G) 5. " " (") 6. Perpendicular bisectors (Ex 1I) 7. Altitude of a triangle (Ex 1K) 8. Medians of a triangle (Ex 1M) 9. Mixed questions (Ex 1O)

2: Sets and Functions Set notation Know the meaning of the terms: domain and range of a function Functions and mappings Composite functions Inverse of a function Graphs of inverses Exponential and log functions	**6 periods** 1. Functions, domains and ranges (Ex 2B) 2. Composition of functions (Ex 2C) 3. Inverse of functions; Graphs of inverses (Ex 2D, WS) 4. Introduction to logarithms (Ex 2H) 5. Mixed questions (Ex 2I) 6. " " (")
SUMMER HOLIDAYS	
3: Recurrence Relations Know the meanings of the terms: sequence, nth term, limit as n tends to infinity Using recurrence relations to solve problems More complex recurrence relations Linear recurrence relations Know the condition for the limit of a sequence Find and interpret the limit of a sequence from a recurrence relation Define and interpret a recurrence relation of the form $U_{n+1} = aU_n + b$ Solving recurrence relations to find a and b. Solving linked recurrence relations Special sequences	**5 Periods** 1. Introduction (Ex 5B, 5D) 2. Linear recurrence relations in context (Ex 5C) 3. Limit of sequences defined by R. R.s (Ex 5H) 4. Forming R. R.s given 3 terms (Ex 5I) 5. Mixed questions (Ex 5L)
5: Graphs of Functions Given the graph of f(x), draw graphs of related functions for: • $y = f(x) + a$	**9 Periods** 1. Standard graphs and $y = f(x) + a$ (Ex 3A, Ex 3C)

• $y = f(x + a)$ • $y = -f(x)$ • $y = f(-x)$ • $y = kf(x)$ • $y = f(kx)$ And combinations of the above functions Know the general features of the graphs of • $f : x \to a^x$ and $f : x \to \log_a x$	2. $y = kf(x)$ including $y = -f(x)$ (Ex 3G, 3K) 3. $y = f(x+a)$ (Ex 3E) 4. $y = f(kx)$ including $y = f(-x)$ (Ex 3M, 3I) 5. Combining transformations and Summary (Ex 3P) 6. Graphs relating to Exponentials and Logs (Ex 3N, 3O)
6: Trigonometry Graphs and Equations Amplitude and period Graphs of $f : x \to \sin(ax + b)$ and $f : x \to \cos(ax + b)$ Radians Using exact values (in degrees and radians) Solving problems using exact values Solving Trig equations graphically and algebraically Solving compound angle equations	**6 Periods** 1. Trig. graphs (Ex 4A, 4B) 2. Radian measure (Ex 4C) 3. Exact Values (Ex 4D, 4E) 4. Trig equations (Ex 4H, 4I) 5. " 6. "
6: Differentiation Know that *f'(x)* is: • rate of change of *f* at *x* • gradient of the tangent to the curve at *x* Know that: • If $f(x) = x^n$ then $f'(x) = nx^{n-1}$ • If $f(x) = g(x) + h(x)$ then $f'(x) = g'(x) + h'(x)$	**13 Periods** 1. Discuss Differentiation by first principles 2. Differentiating x^n (Ex 6D) 3. Finding gradient at a point (Ex 6E) 4. Differentiating kx^n and applications (Ex 6F, 6G, 6H) 5. " 6. Leibnitz notation and equation of tangent (6J) 7. "

• If $f(x) = ax^n$ then $f'(x) = nax^{n-1}$ Applications of derivatives Know how to use Leibniz notation to differentiate $\left(\frac{dy}{dx}\right)$ Differentiation of $\sin x$ and $\cos x$ Equation of the tangent to a curve $y = f(x)$ at $x = a$ Increasing and decreasing functions Stationary points and graph sketching Closed intervals Graphs of derived functions	8. Increasing and decreasing functions (Ex 6L) 9. Stationary points and their nature (Ex 6M) 10. Curve Sketching (Ex 6N) 11. Closed Intervals (Ex 6O) 12. Graph of derived function (Ex 6P) 13. Differentiation of $\sin x$ and $\cos x$ (Ex 14B)
Assessment: A	
OCTOBER HOLIDAYS	
7: Polynomials Evaluating functions using the nested form Synthetic Division by $(x - a)$ Remainder theorem Factor theorem Finding a polynomial's coefficients Solving polynomial equations Functions from graphs Curve sketching Approximate roots / Iteration	**10 Periods** 1. Introduction and synthetic division (Ex 7A, 7B) 2. Remainder Theorem (Ex 7C) 3. Factor Theorem (Ex 7E) 4. Finding coefficients of polynomial (Ex 7F) 5. Solving polynomial equations (Ex 7G) 6. " " " (") 7. Finding equ of polynomial curve with given roots (Ex 7H) 8. Sketching polynomial curves (Ex 7I) 9. " " " (") *Note: Behaviour for large pos/neg x not required* 10. Iteration (Ex 7J)

8: Quadratic Functions Graphs of quadric functions Sketching of quadric functions Reminder – completing the square (from NAT 5) Solving quadric equations and in-equations The quadratic formula Using the discriminant Tangency	**8 Periods** 1. Sketching quadratic graphs (Ex 8C) 2. Completing the square reminder from NAT 5 (Ex 8D) 3. Interpreting completed square form (Ex 8D) 4. Deriving the quadratic formula *May be omitted for lower sets or if time is tight* 5. Solving quadratic inequations (Ex 8F) 6. Discriminant and the nature of roots (Ex 8H) *Note: Rational/irrational roots are not in the textbook but are required!* 7. Finding coefficients given the nature of roots (Ex 8I) 8. Discriminant and tangency (Ex 8J)
9: Integration Know that if $f(x) = F'(x)$ then $\int f(x)\,dx = F(x) + C$ Understand the definite integral, limits of integration Indefinite integrals Rules of integration Definite integrals Area under a curve (approximate and exact using integration) Area between two curves Differential equations	**9 Periods** 1. Introduction and Integrating x^n (Ex 9G) 2. Integrating sums and differences of kx^n (Ex 9H, Ex 9I) 3. " 4. Fundamental theorem of calculus (Ex 9L) 5. " 6. Area between curve and x-axis (Ex 9N) 7. Area between two curves (Ex 9P) 8. Differential equations (Ex 9Q)
10: Optimization Optimization : maximum and minimum	**2 Periods** 9. Optimisation (Ex 6Q, 6R) 10. "

<table>
<tr><td colspan="2">Assessment: B 1</td></tr>
<tr><td>11: The Circle
Revise – distance between two points (straight line topic)
Equation of a circle – centred on the origin and centre (a , b)
Expanded form of the equation of a circle (the general equation of a circle)
Intersection of a line and a circle
Tangents to circles
Finding tangent equations</td><td>8 Periods
1. Distance formula and equ of circle, centre O (Ex 12B, 12D)
2. Equation of circle, centre (a, b), radius r (Ex 12F)
3. General equation of a circle (Ex 12H)
4. “
5. Intersection of line and circle (Ex 12J)
6. “
7. Tangent to a circle (Ex 12K, Ex 12L)
8. “</td></tr>
<tr><td>12: Addition Formulae
Compound angles
• $\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$
• $\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$
Trig identities
• $\sin 2A = 2\sin A\cos A$
• $\cos 2A = \cos^2 A - \sin^2 A$
• $\cos 2A = 2\cos^2 A - 1$
• $\cos 2A = 1 - 2\sin^2 A$
Applications of addition formulae
Trig equations
Formulae for cos^2 x and sin^2 x</td><td>6 Periods
1. Addition formulae (Ex 11B, 11C, 11D)
2. “
3. “
4. Trig identities (Ex 11E, 11F)
5. Double angle formulae (Ex 11G)
6. Trig equations involving double angles (Ex 11H)</td></tr>
<tr><td colspan="2">CHRISTMAS HOLIDAYS</td></tr>
<tr><td colspan="2">Assessment: B 2</td></tr>
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13: Vectors Revise – scalars and vectors, components, magnitude, equal vectors, addition and subtractions, multiplication by a scalar, position vectors and 3D coordinates (from NAT 5) Unit vectors Collinearity Section Formula 3D vectors Scalar Product (formula and component form) Angle between vectors Perpendicular vectors Applications Properties of the scalar product	**11 Periods** 1. Revision of Nat 5 Vectors (Ex 13A, 13B, 13C, 13D, 13E) 2. " 3. Unit vectors & position vectors (Ex 13F, 13G) 4. Collinearity (Ex 13I) 5. Vectors and ratios (NB. Section formula may not be the best approach!) (Ex 13K) 6. 3D and basis vectors (Ex 13L, 13M) 7. Extending rules to 3D (Ex 13N) 8. Scalar product (both forms) (Ex 13O, 13P) 9. Angle between vectors (Ex 13Q) 10. Perpendicular vectors (Ex 13R) 11. Commutative & distributive laws for scalar product (Ex 13U) (NB Ex 13S is well worth doing but may have to be left until after the prelims)
14: Further Calculus Integration of $\sin x$ and $\cos x$ Derivative of $(x+a)^n$ Derivative of $(ax+b)^n$ Chain rule Applications Integrating $(ax+b)^n$ Integrating $\sin(ax+b)$ and $\cos(ax+b)$	**5 Periods** 1. Integrating $\sin x$ and $\cos x$ (Ex 14C) 2. Chain rule (Ex 14H) 3. Applications of chain rule (Ex 14I) 4. Integrating $(ax+b)^n$ (Ex 14J) 5. Integrating $\sin(ax+b)$ and $\cos(ax+b)$ (Ex 14K)
15: Exponential and Log Indices Exponential graphs	**9 Periods** 1. Revision of exponential & log graphs (Teacher)

Exponential growth and decay The exponential function Laws of logs Logarithmic equations Natural logs Formulae from experimental data Related graphs	2. Exponential growth and decay 3. Exponential/log conversion 4. Laws of logarithms 5. Log equations 6. Natural logs 7. Models of the form $y = kx^n$ 8. Models of the form $y = ab^x$ 9. Related graphs	(Ex 15C) (Ex 15E) (Ex 15F) (Ex 15G) (Ex 15H) (Ex 15I) (Ex 15J) (Ex 15K)
16: The wave function Revision - waves and graphs (earlier in the course) Adding two waves The difference of two waves Express $a\cos\theta + b\sin\theta$ in the form $r\cos(\theta \pm \alpha)$ *or* $r\sin(\theta \pm \alpha)$ Multiple angles Maximum and minimum values Solving equations Applications	**6 Periods** 1. Writing in form $k\cos(x-\alpha)$ 2. Writing in forms $k\cos(x+\alpha)$ and $k\sin(x\pm\alpha)$ 3. Wave function with multiple angles (Can be omitted for lower sections) 4. Finding max and min of wave functions 5. Solving equations involving wave functions 6. Applications	 (Ex 16D) (Ex 16E) (Ex 16F) (Ex 16G) (Ex 16H) (Ex 16I)
Assessment: C		
FEBRUARY HOLIDAYS		
EXAM PREPARATION		