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Curriculum Plan - Further Maths

Year 13	Golden Treads: Mathematical augment, language and Proof Mathematical problem solving Mathematical Modelling		Enrichment: Senior Maths Challenge		Review and evaluation: June 2024
	Topics and Substantive Knowledge	**Assessment**	**Misconceptions**	**Key Vocabulary**	**Knowledge tracking**
Term 1 Teacher 1	**Decision 1:** Ch 1 & 2 recap – Algorithms and graphs Ch 3 & 4 recap – Algorithms on graphs Ch 5 – Travelling salesman Explain the differences between the classical and practical problems Use a minimum spanning tree method to find an upper bound Use a minimum spanning tree method to find a lower bound Use the nearest neighbour algorithm to find an upper bound Ch 8 – Critical path analysis – recap plus 8.7 & 8.8. Model a project by an activity network using a precedence table Use dummy activities Identify and calculate early and late event times in activity networks Identify critical activities Calculate the total float of an activity Calculate and use Gantt (cascade) charts Construct resource histograms Construct scheduling diagrams	**Topic tests completed for homework**	Confusing upper and lower bounds Choosing the smallest number when doing a forward pass for the EETs (or vice versa for the LETs). Not putting floats on a Gantt chart	Algorithm Nearest neighbour algorithm Precedence Dummy Early event times Late event times Critical path Float Gantt chart Resource histogram Scheduling diagrams	**Before:** **Decision Ch 5 (from Decision Ch 3)** Distance tables Minimum spanning trees – Prim's and Kruskal's **Decision Ch 8 (from Decision Ch 4)** Route inspection
Teacher 2	**Core Pure 2:** Ch 3 – Calculus Evaluate improper integrals where either the integrand is undefined at a value in the range of integration or the range of integration extends to infinity. Understand and evaluate the mean value of a function. Integrate using partial fractions. Differentiate inverse trigonometric Functions. Be able to choose trigonometric substitutions to integrate associated functions. Extend to quadratic factors $ax^2 + c$ in the denominator. Ch 4 – Volumes of revolution Derive formulae for and calculate volumes of revolution. Both $\pi \int y^2\,dx$ and $\pi \int x^2\,dy$ are required. Students should be able to find a volume of revolution given either Cartesian equations or parametric equations. Ch 5 – Polar coordinates	**Topic tests completed for homework**	Struggle with using the limiting value. Integrating with respect to wrong variable. Relating polar equations to polar graphs.	Limits Undefined Limiting value Derivatives Expansion Validity Parametric and Cartesian Equations of the parabola and	Before: From AS: Definite integrals From A Level: Inverse functions Partial fractions Before: Cartesian coordinates Curve sketching Integration

	Understand and use polar coordinates and be able to convert between polar and Cartesian Coordinates. Sketch curves with r given as a function of θ, including use of trigonometric functions. Find the area enclosed by a polar curve. The sketching of curves such as $r = p \sec(\alpha - \theta)$, $r = a$, $r = 2a\cos\theta$, $r = k\theta$, $r = a(1 \pm \cos\theta)$, $r = a(3 + 2\cos\theta)$, $r = a\cos 2\theta$ and $r^2 = a^2 \cos 2\theta$ may be set. The ability to find tangents parallel to, or at right angles to, the initial line is expected.			rectangular hyperbola Equations of tangents and normals to the above Initial line Area of a Sector	
Term 2 Teacher 1	**Decision 1:** Ch 7 - Simplex algorithm The Simplex algorithm and tableau for maximising and minimising problems with ≤ constraints. The two-stage Simplex and big-M methods. Problems will be restricted to those with a maximum of four variables (excluding slack variables) and four constraints, in addition to non-negativity conditions. Ch 6 – Linear programming recap	**Topic tests completed for homework**	Not fully setting out constraints. Computational errors Not laying work out clearly enough to follow the steps separately Combining 2 or more steps in one tableau Choosing wrong pivot	Simplex Constraint Tableau Pivot Slack variable Artificial variable	Before: Linear programming
Teacher 2	**Core Pure 2:** Ch 6 – Hyperbolics Understand the definitions of hyperbolic functions sinh x, cosh x and tanh x, including their domains and ranges, and be able to sketch their Graphs. Differentiate and integrate hyperbolic Functions. Understand and be able to use the definitions of the inverse hyperbolic functions and their domains and ranges. Derive and use the logarithmic forms of the inverse hyperbolic functions. Be able to choose substitutions to integrate associated functions. Ch 2 – recap of Series Ch 1 – recap of Complex numbers	**Topic tests completed for homework**	Errors often made with arcosh and arcsinh. Standard forms often not used. Using trig identities rather than hyperbolic identities. Integrating inverse trigonometry as trigonometry (not using correct formulae) Confusing the signs of hyperbolic functions (+ve/-ve in different quadrants).		Before: From AS: Trigonometry Exponential functions From A Level: Trigonometry

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Term 3 Teacher 1	Ch 7 - Methods in differential equations Find and use an integrating factor to solve differential equations of and recognise when it is appropriate to do so. Find both general and particular solutions to differential Equations. Use differential equations in modelling in kinematics and in other contexts. Solve differential equations of form y" + ay' + by = 0 where a and b are constants by using the auxiliary Equation. Solve differential equations of form y"+ay'+ by = f(x) where a and b are constants by solving the homogeneous case and adding a particular integral to the complementary function (in cases where f(x) is a polynomial, exponential or trigonometric function). Understand and use the relationship between the cases when the discriminant of the auxiliary equation is positive, zero and negative and the form of solution of the differential equation. The integrating factor e∫ P(x)dx may be quoted without proof. Ch 8 - Modelling with differential equations Solve the equation for simple harmonic motion $d^2x/dt^2 = -\omega^2x$ and relate the solution to the motion. Model damped oscillations using second order differential equations and interpret their solutions. Analyse and interpret models of situations with one independent variable and two dependent variables as a pair of coupled first order simultaneous equations and be able to solve them, for example predator-prey models. Damped harmonic motion, with resistance varying as the derivative of the displacement, is expected. Problems may be set on forced vibration.	**Y13 Internals – full length Core Pure paper, Decision paper (and AS Further Mechanics in class)**	Many students struggle to set up the correct model for the differential equation. Integrating with respect to the wrong variable	First Order Separating the variables Second Order Integrating factor Auxiliary equation Complementary equation Particular solution Boundary conditions General solution Simple harmonic motion Coupled first order	Before: From A Level: Differentiation Integration Before: From AS: Vectors in 2D From A Level: Vectors in 3D
Teacher 2	<u>**Further mechanics 1:**</u> Ch 3 – Elastic Strings Elastic strings and springs. Hooke's law. Energy stored in an elastic string or spring. Ch 4 – Elastic Collisions Direct impact of elastic spheres. Newton's law of restitution. Loss of kinetic energy due to impact. Successive direct impacts of spheres and/or a sphere with a smooth plane surface. Problems using the work-energy principle involving kinetic energy, potential energy and elastic energy may be set. Oblique impact of smooth elastic spheres and a smooth sphere with a fixed surface. Loss of kinetic energy due to impact. Problems will only involve spheres with the same radius. Problems may be set in vector form. The spheres may be modelled as particles. 5.2 Successive oblique impacts of a sphere with smooth plane surfaces.	**Topic tests completed for homework**	Often misunderstandings about oblique angles.		Before: From AS: Kinematics Vectors Vectors (Pure) Integration (Pure) From A Level: Further kinematics in 2D Resolving forces Frictional forces Dynamics

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Term 4 Teacher 1	**Revision and catch up**				
Teacher 2	**Further mechanics 1:** **Recap of Chapters 1, 2 and 4** **Revision and catch up**	Exam papers set as homework and a couple set as practice papers in exam conditions in class	Magnitude of velocity often incorrectly answered. Equation of motion often incorrectly set up. Errors with natural length quite common.		
Term 5 Teacher 1	**Revision and catch up**				
Teacher 2	**Revision and catch up**				