

Further Maths AS-level Scheme of Learning

Summary

Teacher A

Further Pure 1

Teacher B

Mechanics 1B

Splitting Decision 2

Teacher A

Allocation
Simplex Algorithm
Game Theory

Teacher B

Network Flows
Critical Path Analysis
Dynamic Programming

A and B in D2 split need not be the same A and B as in FP1/M1 split.

More detailed breakdown on next page.

All modules to be examined in May/June.

Assessment for Learning should be a regular and ongoing process. Targets can be based initially on ALIS predictors and Maths GCSE scores with QECC predictors published in reports around Christmas.

Main resource is Further Pure 1 & Mechanics 1 text books (issued to students) together with Decision 2 text book (out of print) for staff, photocopies to students – chapter references in breakdown. Other learning activities listed. Asterisk indicates PL has some kit to support this. They can buy Graphics calculators at a reduced rate from the library and these used to enhance the curriculum. Graphing programs eg Omnigraph can be used instead or as well.

Additionally some useful websites are listed overleaf.

Batches of Past Papers will be made available by PL for all modules together with worked solutions (not necessarily with correct answers but methods not to be faulted!) in folders in C2. Some suggestions for using past papers (beyond the obvious):

- Working in pairs, hand out the answers and ask students to reconstruct the questions.
- Give each pair a question from a past paper and ask them to create the mark scheme then compare their mark scheme with the official one. This can help identify aspects of the questions that the examiners feel are important and award marks for.
- Underline key words and phrases in the questions and ask pairs to explain them – these can be general instruction words like ‘hence’ or specific mathematical words like 'determinant'. This can help identify areas for further revision as well as reinforcing the meaning of instruction words.
- Hand out a solution to an exam question with the steps in the wrong order and ask pairs to rearrange the steps to construct the answer. For an additional challenge you can miss out some steps and ask the learners to write them in themselves.

Recommended websites

Content	Web address
Mathematics activities, puzzles and a forum for asking for help with mathematics questions	www.nrich.maths.org
Collection of interactive resources covering the further mathematics specification	www.mathsnet.net
Rich starting points for investigations at A-level	www.risps.net
Resources for teaching further mathematics topics	www.plymouth.ac.uk/math
Online resources covering the mathematics specifications for all awarding bodies	www.mei.org.uk
Details of enrichment activities for further mathematics students	www.fmnetwork.org.uk
Java applets for mechanics	www.walter-fendt.de/download/ph14dl.htm

Further Pure 1 (Teacher A)

Topic	Learning Objectives/Outcomes	Notes	Teaching/Learning Activities/Resources
Algebra and Graphs	Graphs of rational functions of the form $\frac{ax+b}{cx+d}$ $\frac{ax+b}{cx^2+dx+e}$ or $\frac{x^2+ax+b}{x^2+cx+d}$	Sketching the graphs. Finding the equations of the asymptotes which will always be parallel to the coordinate axes. Finding points of intersection with the coordinate axes or other straight lines. Solving associated inequalities. Using quadratic theory (not calculus) to find the possible values of the function and the coordinates of the maximum or minimum points on the graph.	Chap 3 Chap 11 Chap 12 Gcalc
	Graphs of parabolas, ellipses and hyperbolas with equations $y^2=4ax$ $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ $xy=c^2$	Sketching the graphs. Finding points of intersection with the coordinate axes or other straight lines. Candidates will be expected to interpret the geometrical implication of equal roots, distinct real roots or no real roots. Knowledge of the effects on these equations of single transformations of these graphs involving translations, stretches parallel to the x - or y - axes, and reflections in the line $y=x$. Including the use of the equations of the asymptotes of the hyperbolas given in the formulae booklet	Chap 13 Gcalc
Complex numbers	Non-real roots of quadratic equations	Complex conjugates – awareness that non-real roots of quadratic equations with real coefficients occur in conjugate pairs.	Chap 2
	Sum, difference and product of complex numbers in the form $x+iy$		
	Comparing real and imaginary parts.	Including solving equations involving z^* where z^* is the conjugate of z	

Roots and coefficients of a quadratic equation	Manipulating expressions involving $\alpha+\beta$ and $\alpha\beta$	E.g. Expressing $\alpha^3+\beta^3$ in terms of $\alpha+\beta$ and $\alpha\beta$ E.g. Forming an equation with roots α^3 and β^3	Chap 1
Series	Use of formulae for the sum of the squares and the sum of the cubes of the natural numbers	E.g. To find polynomial expressions for summations	Chap 9
Calculus	Finding the gradient of the tangent to a curve at a point, by taking the limit as h tends to zero of the gradient of a chord joining two points whose x -coordinates differ by h .	The equation will be given as $y=f(x)$ where $f(x)$ is a simple polynomial	Chap 8
	Evaluation of simple improper integrals.	Where the integrand is undefined at some point in the range or one of the limits is $\pm\infty$	
Numerical Methods	Finding roots of equations by interval bisection, linear interpolation and the Newton-Raphson method.	Graphical illustration of these methods.	Chap 10 Gcalc
	Solving differential equations of the form $\frac{dy}{dx}=f(x)$	Using a step-by-step method based on linear approximations	
	Reducing a relation to a linear law	Use of logarithms to base 10 where appropriate. Given numerical values of (x,y) drawing a linear graph and using it to estimate the values of the unknown constants.	Chap 7
Trigonometry	General solutions of trigonometric equations including use of exact values for the sine, cosine and tangent of $\frac{\pi}{6}$, $\frac{\pi}{4}$, $\frac{\pi}{3}$		Chap 5 Gcalc

<p>Matrices and transformations</p>	<p>2x2 and 2x1 matrices; addition and subtraction, multiplication by a scalar. Multiplying a 2x2 matrix by a 2x2 matrix or by a 2x1 matrix. The identity matrix I for a 2x2 matrix.</p>		<p>Chap 4</p>
	<p>Transformations of points in the x-y plane represented by 2x2 matrices.</p>	<p>Transformations will be restricted to rotations about the origin, reflections in a line through the origin, stretches parallel to the x – and y – axes, and enlargements with centre the origin. Use of the standard transformation matrices given in the formulae booklet. Combinations of these transformations</p>	<p>Chap 6</p>

Mechanics 1 (Teacher B)

Topic	Learning Objectives/Outcomes	Notes	Teaching/Learning Activities/Resources
Mathematical Modelling	Use of assumptions in simplifying reality.	Candidates are expected to use mathematical models to solve problems.	Chap 1 <i>Leeds Mechanics kit, Mechanics videos, “Challenging Concepts in Mechanics” (Berry & Graham) – can be used throughout module</i>
	Mathematical analysis of models.	Modelling will include the appreciation that: it is appropriate at times to treat relatively large moving bodies as point masses; the friction law $F \leq \mu R$ is experimental; the force of gravity can be assumed to be constant only under certain circumstances.	
	Interpretation and validity of models.	Candidates should be able to comment on the modelling assumptions made when using terms such as particle, light, inextensible string, smooth surface and motion under gravity.	
	Refinement and extension of models.		
Kinematics in one and two dimensions	Displacement, speed, velocity, acceleration		Chap 2 Motion detector
	Sketching and interpreting kinematics graphs	Understanding the difference between displacement and distance. Use of gradients and area under graphs to solve problems	
	Use of constant acceleration equations. $s=ut + \frac{1}{2}at^2$ $s=ut + \frac{1}{2}at^2$ $s=vt - \frac{1}{2}at^2$ $s=vt - \frac{1}{2}at^2$ $v=u+at$ $v=u+at$ $s=\frac{1}{2}(u+v)t$ $s=\frac{1}{2}(u+v)t$ $v^2=u^2+2as$		
	Vertical motion under gravity		
	Average speed and average velocity		

	Application of vectors in two dimensions to represent position, velocity or acceleration	Resolving quantities into two perpendicular components	Chap 3
	Use of unit vectors i and j	Candidates may work with column vectors	
	Magnitude and direction of quantities represented by a vector		
	Finding position, velocity, speed and acceleration of a particle moving in two dimensions with constant acceleration	The solution of problems such as when a particle is at a specified position or velocity, or finding position, velocity or acceleration at a specified time. Use of constant acceleration equations in vector form	
	Problems involving resultant velocities	To include solutions using either vectors or vector triangles	
Statics and Forces	Drawing force diagrams, identifying forces present and clearly labelling diagrams	Candidates should distinguish between forces and other quantities such as velocity, that they might show on a diagram	Chap 4
	Force of gravity (Newton's Universal Law not required)	The acceleration due to gravity, g , will be taken as 9.8 ms^{-2}	
	Friction, limiting friction, coefficient of friction and the relationship of $F \leq \mu R$	Candidates should be able to derive inequalities from the relationship $F \leq \mu R$	
	Normal reaction forces		
	Tensions in strings and rods, thrusts in rods		
	Modelling forces as vectors	Candidates will be required to resolve forces only in two dimensions	
	Finding resultant of a number of forces acting at a point	Candidates will be expected to express the resultant using components of a vector and to find the magnitude and direction of the resultant	
	Finding the resultant force acting on a particle		
	Knowledge that the resultant force is zero if a body is in equilibrium	Find unknown forces on bodies that are at rest	

Momentum	Concept of momentum	Momentum as a vector in one or two dimensions. (Resolving velocities is not required.) Momentum= mv	Chap 8
	The principle of conservation of momentum applied to two particles	Knowledge of Newton's law of restitution is not required	
Newton's Laws of Motion	Newton's three laws of motion	Problems may be set in one or two dimensions	Chap 5
	Simple applications of the above to the linear motion of a particle of constant mass	Including a particle moving up or down an inclined plane	
	Use of $F=\mu R$ as a model for dynamic friction		
Connected Particles	Connected particle problems	To include the motion of two particles connected by a light inextensible string passing over a smooth fixed peg or a smooth light pulley, when the forces on each particle are constant. Also includes other connected particle problems, such as a car and trailer	Chap 6
Projectiles	Motion of a particle under gravity in two dimensions.	Candidates will be expected to state and use equations of the form $x=V \cos \alpha t$ and $y=V \sin \alpha t - \frac{1}{2}gt^2$ Candidates should be aware of any assumptions they are making	Chap 7
	Calculate range, time of flight and maximum height	Formulae for the range, time of flight and maximum height should not be quoted in examinations. Inclined plane and problems involving resistance will not be set. The use of the identity $\sin 2\theta=2\sin\theta\cos\theta$ will not be required. Candidates may be expected to find initial speeds or angles of projection	
	Modification of equations to take account of the height of release		