Unit M2 – Mechanics

The examination

The examination will consist of one 1½ hour paper. It will contain about seven questions with varying mark allocations per question which will be stated on the paper. All questions may be attempted.

Candidates are expected to know any other formulae which might be required by the specification and which are not included in the booklet, *Mathematical Formulae including Statistical Formulae and Tables*, which will be provided for use with the paper. Questions will be set in SI units and other units in common usage.

Candidates are expected to have available a calculator with at least the following keys: +, −, ×, ÷, π, x^2, $\sqrt{x}$, $\frac{1}{x}$, x^y, ln x, e^x, sine, cosine and tangent and their inverses in degrees and decimals of a degree, and in radians; memory. Calculators with a facility for symbolic algebra, differentiation and/or integration are not permitted.

Formulae

Candidates will be expected to know and be able to recall and use the following formulae:

Kinetic energy = $\frac{1}{2}mv^2$

Potential energy = mgh

Prerequisites

A knowledge of the specification for M1 and its prerequisites and associated formulae, together with a knowledge of algebra, trigonometry, differentiation and integration, as specified in C1, C2 and C3, is assumed and may be tested.

	SPECIFICATION	NOTES
	1. Kinematics of a particle moving in a straight line or plane	
S	Motion in a vertical plane with constant acceleration, eg under gravity.	
S	Simple cases of motion of a projectile.	
S	Velocity and acceleration when the displacement is a function of time.	The setting up and solution of equations of the form $\frac{dx}{dt} = f(t)$ or $\frac{dv}{dt} = g(t)$ will be consistent with the level of calculus in C2.
S	Differentiation and integration of a vector with respect to time.	For example, given that $\mathbf{r} = t^2\mathbf{i} + t^{3/2}\mathbf{j}$, find $\dot{\mathbf{r}}$ and $\ddot{\mathbf{r}}$ at a given time.

	2. Centres of mass	
N	Centre of mass of a discrete mass distribution in one and two dimensions.	
N	Centre of mass of uniform plane figures, and simple cases of composite plane figures.	The use of an axis of symmetry will be acceptable where appropriate. Use of integration is not required. Figures may include the shapes referred to in the formulae book. Results given in the formulae book may be quoted without proof.
S	Simple cases of equilibrium of a plane lamina.	The lamina may (i) be suspended from a fixed point; (ii) free to rotate about a fixed horizontal axis; (iii) be put on an inclined plane.
	3. Work and energy	
N	Kinetic and potential energy, work and power. The work-energy principle. The principle of conservation of mechanical energy.	Problems involving motion under a constant resistance and/or up and down an inclined plane may be set.
	4. Collisions	
S	Momentum as a vector. The impulse-momentum principle in vector form. Conservation of linear momentum.	
N	Direct impact of elastic particles. Newton's law of restitution. Loss of mechanical energy due to impact.	Candidates will be expected to know and use the inequalities $0 \leq e \leq 1$ (where e is the coefficient of restitution).
N	Successive impacts of up to three particles or two particles and a smooth plane surface.	Collision with a plane surface will not involve oblique impact.
	5. Statics of rigid bodies	
S	Moment of a force.	
S	Equilibrium of rigid bodies.	Problems involving parallel and non-parallel coplanar forces. Problems may include rods or ladders resting against smooth or rough vertical walls and on smooth or rough ground.