

Mechanics 1

Edexcel IAL M1 (WME01/01); a permitted applied unit of Further Mathematics
after the pure units

1. Unit M1 at a glance

Unit M1 at a glance

WME01/01: 1 hour 30 minutes, 75 marks, $g = 9.8 \text{ m s}^{-2}$, answers to 2–3 s.f.

Must-know (not in the booklet): momentum mv , impulse $mv - mu$, the five suvat formulae, $F = \mu R$ when moving.

2. Mathematical models in mechanics

Modelling words

Particle, lamina, rod, rigid body; light = massless, uniform = centre of mass at the midpoint; inextensible string keeps both ends at one speed; smooth versus rough surfaces; light smooth pulley turns tension without changing it.

3. Vectors in mechanics

Vectors

$|a\mathbf{i} + b\mathbf{j}| = \sqrt{a^2 + b^2}$; resultants add component-wise; $\mathbf{r}(t) = \mathbf{r}_0 + t\mathbf{v}$; bearings clockwise from north. WME01 demand: from two instants find the velocity, generalise the position, then the bearing of B from A at a set time ($-5\mathbf{i} - 12\mathbf{j} \rightarrow 203^\circ$).

4. Kinematics in a straight line

Kinematics

Per-phase suvat with signs fixed; graphs carry the marks: velocity-time gradient a and area s , speed-time a V with vertex ON the axis. Up 12 m and down to the ground in 4 s: $-12 = 4U - 4.9(16)$ gives $U = 16.6$, landing speed 22.6.

5. Newton's laws and connected particles

Newton's laws

$F = ma$ per body along the line; inclines: $R = mg \cos \theta$, $\tan \theta = \frac{3}{4}$ means $\sin \frac{3}{5}$, $\cos \frac{4}{5}$.
Pulleys: paired equations eliminate T ($k = 2$ in WME01), force on pulley $= 2T = 23.5$ N, and each landing or slack string starts a NEW phase.

6. Momentum and impulse

Momentum

Momentum mv , impulse $I = mv - mu$, signed along the line; reversals make $I = m(u + v)$ in magnitudes. Third law: impulses on the two colliding bodies are equal and opposite — use one. $3m(v - 2u) = 4.5mu$ gives $v = 3.5u$; on P: $3kmu = 4.5mu$, $k = 1.5$.

7. Friction

Friction

Contact splits into R and F ; moving or limiting: $F = \mu R$, otherwise $F \leq \mu R$. WME01's rough slope: $a = g(\sin \theta + \mu \cos \theta) = \frac{4}{5}g$ exact; held at rest, $X = \frac{4}{5}g = 7.84$ N with friction helping up the slope.

8. Statics of a particle

Statics

Resolve in two directions, both totals zero, or close the vector triangle: two strings at 40° and 60° carrying 50 N give $T_1 = 44$, $T_2 = 33$ N. On rough ground the reaction's friction component is whatever closes the polygon, capped at μR .

9. Moments

Moments

Force times perpendicular distance about a pivot of your choosing; tilting about a named point zeroes the other reactions. The ledge rod: $3aP = Wd$ about A, $1.25Pa = W(2a - d)$ about C, together giving $d = \frac{24a}{17}$.

Check yourself

Check yourself

State modelling assumptions and their consequences; vector velocities, positions, bearings; multi-phase suvat and motion graphs; paired equations over a pulley with the 2T pulley force; impulse on one body and momentum conservation with rebounds; μR moving versus capped at rest; equilibrium by two resolutions; moments about successive tilting pivots.