

Mechanics 1 (M1)

Edexcel IAL Maths · Knowledge organiser



KEY DEFINITIONS

Particle

A body treated as a point: its size is ignored.

Momentum

Mass $\times$ velocity; it is conserved in a collision when no outside force acts.

Impulse

Change in momentum: $I = mv - mu = Ft$.

Limiting friction

The greatest friction possible, $F = \mu R$, when sliding is about to start.

YOU SHOULD BE ABLE TO...

- Describe how mechanics models are built and refined, and state assumptions such as modelling an object as a particle or a rope as light and inextensible.
- Distinguish distance from displacement and speed from velocity, and use travel graphs to find total distance travelled when motion changes direction.
- Apply Newton's second law $F = ma$ to particles moving in a straight line under several forces, finding accelerations, forces and masses.
- Calculate momentum and impulse, and use impulse = change in momentum to find velocities or forces in one-dimensional problems.
- Solve equilibrium problems with limiting friction, finding the least or greatest force needed to keep a particle at rest on a rough surface.
- Solve problems where a rod is on the point of tilting about a support, using the fact that the other reaction is zero.

COMMON MISTAKES

- ✗ Too many significant figures after using $g = 9.8$
- ✗ Momentum: directions and signs
- ✗ Area under a v-t graph read as acceleration
- ✗ Sign convention changed mid-question

KEY FORMULAS

suvat	$v = u + at, \quad s = ut + \frac{1}{2}at^2, \quad s = vt - \frac{1}{2}at^2,$ $s = \frac{1}{2}(u + v)t, \quad v^2 = u^2 + 2as$
Vectors	$\mathbf{v} = \mathbf{u} + \mathbf{at}, \quad \mathbf{r} = \mathbf{r}_0 + \mathbf{vt}, \quad \text{speed} = \mathbf{v} $
Newton's 2nd law; weight	$F = ma, \quad W = mg \quad (g = 9.8 \text{ m s}^{-2})$
Friction	$F \leq \mu R; \quad \text{limiting } F = \mu R$
Momentum; impulse	$p = mv; \quad I = Ft = mv - mu$
Conservation of momentum	$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$
Moments	$\text{moment} = F \times d_{\perp};$ equilibrium: $\sum F = 0, \quad \sum M = 0$
Slope at θ : weight component $mg \sin \theta$ down the slope; $R = mg \cos \theta$ if nothing else acts perpendicular to it	
Velocity-time graph: gradient = acceleration, area = displacement	

WORKED EXAMPLE

A particle of mass 2 kg moving at 3 m s⁻¹ hits a particle of mass 1 kg at rest. They join together. Find their common speed.

1. Momentum before = $2 \times 3 + 1 \times 0 = 6$

2. Momentum after = $(2 + 1)v$

Answer: $v = 2 \text{ m s}^{-1}$