M2

Kinematics of a particle moving in a straight line or plane

For variable acceleration, the relationships between the displacement x, velocity v and acceleration a of a particle are shown by:

Differentiate w.r.t. t	$\Downarrow$	x | v | a	$\Uparrow$	Integrate w.r.t. t

A single dot above a vector implies a first derivative, two dots a second derivative, with respect to t.

Speed = | **v** |

Centres of mass

Body	**Centre of mass**
Uniform rod	mid-point of rod
Uniform rectangular lamina	point of intersection of lines joining mid-pounds of opposite sides
Uniform circular disc	centre of circle
Uniform triangular lamina	point of intersection of the mesians – on other words 2/3 distance from any vertex to any mid-point on the opposite side
Circular arc, radius r, angle at centre 2α	$(r \sin \alpha) / \alpha$ from centre
Sector or circle, radius r, angle at centre 2α	$(2r \sin \alpha) / 3\alpha$ from centre

For a lamina which Is freely suspended and hangs in equilibrium, the centre of mass will be vertically below the point of suspension.

Work, Energy and Power

Work

Work done = force x distance moved

1N does 1J of work when moving a particle a distance of 1m

Energy

K.E. = $0.5mv^2$

P.E. = mgh

Work done on a body is equal to its change of mechanical energy, which is K.E. + P.E.

Conservation of Energy

K.E. + P.E. = constant

Power

Power = driving force x speed

Power is measured in Watts, where 1 Watt (W) is 1 Joule per second, or kilowatts where 1 kilowatt (kW) is 1000 Watts.

Collisions

Conservation of linear momentum

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Newton's law of restitution

e = speed of separation of particles / speed of approach of particles

which can be written as:

(speed of rebound) = e (speed of approach)

Statics of rigid bodies

A rigid body is in equilibrium if:

1. The vector sum of the forces acting is zero, that is the sum of the components of the forces in any given direction is zero.
2. The algebraic sum of the moments of the forces about any given point is zero

Only in the case of limiting equilibrium, when motion is on the point of taking place, does the friction force have its maximum value, μR.