OCR A Further Maths AS-level

Mechanics

Formula Sheet

Provided in formula book	Not provided in formula book

Work, Energy and Power

Work Done

Unit	$1\text{J} = 1\text{Nm}$
Work done by a force acting in the direction of motion	$\text{work done (J)} = \text{force (N)} \times \text{distance(m)}$ $= Fd$
Work done by or against gravity	$\text{work done (J)} = \text{weight (N)} \times \text{height(m)}$ $= mgh$

Energy

Kinetic Energy	$\text{KE} = \frac{1}{2}mv^2$
Work-Energy Principle	$\text{net work done} = \text{final KE} - \text{initial KE}$ $= \frac{1}{2}mv^2 - \frac{1}{2}mu^2$
Gravitational Potential Energy	$\text{GPE} = mgh$
Principle of Conservation of Mechanical Energy	$\text{GPE} + \text{KE} = mgh + \frac{1}{2}mv^2 = \text{constant}$
$\text{GPE}_1 + \text{KE}_1 + \text{work done by driving forces} - \text{work done against resistive forces} = \text{GPE}_2 + \text{KE}_2$	

Work Done by Force at an Angle

For force acting at an angle θ to the direction of movement
$\text{work done} = \text{force} \times \cos\theta \times \text{distance}$

Power

Unit	$1\text{W} = 1\text{Js}^{-1}$
Average Power	$\text{Average power} = \frac{\text{work done}}{\text{time taken}} = \frac{Fd}{t}$
Power	$\text{Power} = \text{tractive force} \times \text{speed}$

Impulse and Momentum

Momentum	$\text{momentum} = \text{mass} \times \text{velocity}$ $= mv$
Impulse of a constant force	$I = \text{force} \times \text{time} = Ft$ $= \text{change in momentum} = mv - mu$

Collisions

Conservation of Momentum	If there are no external impulses: $\text{total momentum before collision} = \text{total momentum after collision}$ $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$
Newton's Experimental Law for Two Smooth Spheres	$\frac{\text{speed of separation}}{\text{speed of approach}} = -e$ $\frac{v_1 - v_2}{u_1 - u_2} = -e$ For $0 \le e \le 1$ where e is the coefficient of restitution
Newton's Experimental Law for a Smooth Sphere and a Fixed Plane Surface	$v = -eu$

Motion in a Circle

Constant Acceleration

For a particle moving in a horizontal circular path of radius r m with constant angular speed $\dot{\theta}$ rad s^{-1}	
Linear (Tangential) Speed	$v = r\dot{\theta}$ $\dot{\theta} = \frac{d\theta}{dt}$
Radial Acceleration	$a = r\dot{\theta}^2 = v\dot{\theta} = \frac{v^2}{r}$ Towards the centre of circular motion