Edexcel Further Maths A-level

Further Mechanics 1

Formula Sheet

Provided in formula book

Not provided in formula book

Work, Energy and Power

$$Work\ done = Component\ of\ force\ in\ direction\ of\ motion \times Distance\ moved\ in\ direction\ of\ force$$

$$Work\ done\ against\ gravity = mgh$$

$m - mass\ of\ particle$
$g - acceleration\ due\ to\ gravity$
$h - vertical\ distance\ raised$

$$Work\ done = Change\ in\ kinetic\ energy = \frac{1}{2}m(v^2 - u^2)$$

Work Energy Principle

$$Change\ in\ the\ total\ energy\ of\ a\ particle = Work\ done\ on\ the\ particle$$

Kinetic energy	$K.E = \frac{1}{2}mv^2$
Potential energy	$P.E = mgh$

Conservation of Mechanical Energy

When no external forces (other than gravity) do work on a particle during motion, the sum of the particle's potential and kinetic energy is constant.

$$KE_{initial} + PE_{initial} = KE_{final} + PE_{final}$$

$$\frac{1}{2}mu^2 + mgh_{initial} = \frac{1}{2}mv^2 + mgh_{final}$$

$$Power = \frac{Work\ done}{Time} = Force \times Velocity$$

Elastic Strings and Springs

Hooke's Law

Tension is proportional to extension:

$T \propto x$	$T = kx$

$T - tension$ $x - extension$ $\lambda - modulus\ of\ elasticity$ $l_o - natural\ length$	$T = \frac{\lambda}{l_o} \times x$

Elastic Potential Energy

$$E.P.E = \frac{\lambda x^2}{2l_o}$$

Elastic potential stored in a strectched spring/string
= Amount of work done to stretch the spring/string

When no external forces (other than gravity) act on a particle:

$$E.P.E_{initial} + K.E_{initial} + G.P.E_{initial} = E.P.E_{final} + K.E_{final} + G.P.E_{final}$$

Momentum and Impulse

$$Momentum = Mass \times Velocity$$
$$Impulse = Force \times Time$$

Impulse-Momentum Principle

$$Impulse = Change\ in\ Momentum = mv - mu$$

Conservation of Momentum

Total Momentum Before a Collision = Total Momentum After a Collision

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

Elastic Collisions in One Dimension

Newton's law of restitution $(e - coefficient\ of\ restitution)$	$\frac{Speed\ of\ separation\ of\ particles}{Speed\ of\ approach\ of\ particles} = e$
	$\frac{v_b - v_a}{u_a - u_b} = e$

For the collision of a particle with a smooth plane:

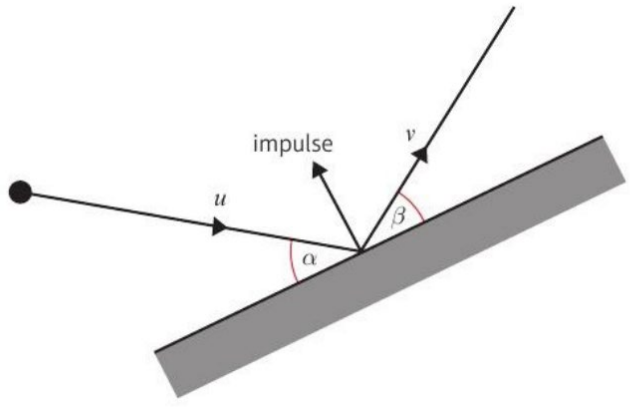
$$\frac{Speed\ of\ rebound}{Speed\ of\ approach} = \frac{v}{u} = e$$

$0 \leq e \leq 1$	
$e = 0$	$e = 1$
Perfectly inelastic collision	Perfectly elastic collision

Loss of kinetic energy due to impact:

$$\left(\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2\right) - \left(\frac{1}{2}m_1v_1 + \frac{1}{2}m_2v_2^2\right)$$

Elastic Collisions in Two Dimensions



$$\boldsymbol{vcos\beta = ucos\alpha}$$
$$\boldsymbol{tan\beta = etan\alpha}$$