Year 13 Knowledge Organiser Mechanics

1. Moments

Clockwise moment of F about P =	$\|F\|$ x d
Clockwise moment of F about P =	$\|F\|$ x dsin θ
Coplanar forces	Forces that act in the same plane
Resultant moment	The sum of the moments acting on a body
When a rigid body is in equilibrium…	The resultant force in any direction is 0N and the resultant moment about any point is 0N
Non-uniform rod	The centre of mass is not at midpoint of the rod
When a body is on the point of tilting about a pivot…	The reaction at any other support (or the tension in any other wire or string) is 0

2. Forces & Friction

The component of a force	The effect of the force in the direction of motion
The component of a force magnitude F in a certain direction is…	Fcos θ, where θ is the size of angle between the force and the direction
Maximum/limiting value	Force at which a stationary object will move
F_{max}=	μR μ is the coefficient of friction, R is the normal reaction between the two surfaces

3. Projectiles

The horizontal motion of a projectile is modelled as having…	Constant velocity (a = 0)
You can use the formula s=	vt
The vertical motion of a projectile is modelled as having…	Constant acceleration doe to gravity (a=g)
Horizontal component of the initial velocity for projected particle	Ucos α
Vertical component of the initial velocity for projected particle	Usin α
U=	Initial velocity
α =	Angle above horizontal
A projectile reaches its point of greatest height when the…	Vertical component of its velocity is equal to 0
Time of flight=	$\frac{2Usin\alpha}{g}$
Time to reach greatest height=	$\frac{Usin\alpha}{g}$
Range on horizontal plane=	$\frac{U^2 sin2\alpha}{g}$
Equation of trajectory	$y = xtan\alpha - gx^2\frac{(1+tan^2\alpha)}{2U^2}$
y	Vertical height of particle
x	Horizontal distance from point of projection
g	Acceleration due to gravity

4. Application of Forces

A particle or rigid body is in static equilibrium if…	It is at rest and the resultant force acting on the particle is 0

Limiting equilibrium	When a body is on the point of moving
F_{max} is reached when...	The body is in limiting equilibrium
The force of friction F is such that	$F \leq \mu R$
The direction of the frictional force is opposite to...	The direction in which the body would move if the frictional force were absent
For a rigid body in static equilibrium	• The body is stationary • The resultant force in any direction is 0 • The resultant moment is 0
5. Further Kinematics	
Position vector for particle **r** =	$\mathbf{r}_o + \mathbf{v}t$
$\mathbf{r}_o$=	Position vector for starting point
v=	Constant velocity
Displacement from initial position at time t	**v**t
Object moving in plane with constant acceleration **v**=	**u** + **a**t
Object moving in plane with constant acceleration **r**=	$\mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$
u=	Initial velocity
a=	Acceleration
v=	Velocity at time t
r=	Displacement at time t
If **r** = x**i** + y**j**, **v**=	$\frac{dr}{dt} = \dot{r} = \dot{x}i + \dot{y}j$
If **r** = x**i** + y**j**, **a**=	$\frac{dv}{dt} = \frac{d^2r}{dt^2} = \ddot{r} = \ddot{x}i + \ddot{y}j$
v=	$\int a\, dt$
r=	$\int v\, dt$