Mechanics 2 Key Skills Checklist

How confident are you with each topic? √ *confident* – *not very sure* × *very unsure*

Chapter 1: Moments and equilibrium	
Define and calculate the moment of forces about a given point.	
Use moments as well as resolving forces to deal with situations in equilibrium.	

Chapter 2: Centres of mass	
Find the centre of mass of a 1D system (eg rod with point masses).	
Identify the centre of mass for simple shapes such as rectangles.	
Find the centre of mass of a 2D system (eg compound rectangular shapes made from a uniform lamina) by taking moments.	

Chapter 3: Energy	
Quote and use the formula $KE = \frac{1}{2}mv^2$ for kinetic energy.	
Quote and use the formula $GPE = mgh$ for gravitational potential.	
Understand and use $WD = Force \times Distance$ for work done.	
Use the conservation of energy principle to solve problems, taking into account energy 'lost' due to work done against motion (eg, by friction).	
Understand the concept of power (energy transferred in a given time) and be able to use and apply the formula $P = Fv$, using the principles of resultant forces and motive forces to solve problems.	
Understand and apply Hooke's law for springs $T = \frac{\lambda x}{l}$.	
Be able to demonstrate using integration that the energy stored by a spring (the elastic potential energy) is given by $EPE = \frac{\lambda e^2}{2l}$.	
Use a combination of kinetic, gravitational and elastic potential and work done to solve problems involving conservation of energy.	

Chapter 4: Kinematics and variable acceleration	
Calculate velocity from an expression for displacement in terms of the time t, for 1D problems, by differentiating.	
Calculate acceleration from an expression for velocity in terms of the time t, for 1D problems, by differentiating.	
Calculate velocity from an expression for displacement in terms of the time t, for 2D problems, given in vector form.	
Calculate acceleration from an expression for velocity in terms of the time t, for 2D problems, given in vector form.	
Use integration to find an expression for velocity from acceleration or displacement from velocity, taking into account initial conditions to determine the value of any constants of integration (in 1D or 2D).	

Chapter 5: Circular motion	
Understand the concept of angular speed, and use $\omega = \frac{\theta}{t}$.	
Convert from rpm to the standard units of ω, $rad\ s^{-1}$.	
Calculate the time period of circular motion at a constant speed using $T = \frac{2\pi}{\omega}$, and understand the derivation of this formula.	
Understand and use the formula $v = r\omega$ for speed, recalling that the direction of velocity is always tangential to the circle.	
Understand and use the formula $a = r\omega^2$ for centripetal acceleration, recalling that the direction of acceleration is always at right angles to motion (that is, always directed towards the centre of the circle).	
Use $F = ma$ to generate an expression for centripetal force either in terms of ω or v.	
Deal with circular motion with constant speed (eg horizontal circles) by resolving forces at right angles to the plane of motion (vertically) – note that these forces are in equilibrium, and resolving radially (towards the centre) – note that this force is the centripetal force, which is therefore equal to $\frac{mv^2}{r}$ or $mr\omega^2$.	

Chapter 6: Circular motion with variable speed	
Use conservation of energy and resolving forces radially to interpret vertical circles problems.	
Recall and use conditions for describing complete circles in fixed circles (bead on a wire, roller-coaster) as well as conditions for oscillation.	
Recall and use conditions for describing complete circles in inner circles (particle on a string, car on a loop-the-loop track) as well as conditions for falling into the circle and oscillation.	
Recall and use knowledge of the normal reaction to interpret outer circles problems (particle rolling off a sphere, car on a hump-backed bridge) and to determine the point at which a particle will leave the surface.	
Resolve forces towards the centre to determine centripetal acceleration, direction and magnitude of velocity for a given position.	
Find overall acceleration by combining tangential and radial acceleration (eg a car accelerating around a corner).	

Chapter 7: Application of differential equations in mechanics	
Understand how integration can be used to find displacement from velocity or velocity from acceleration, and the significance of the constant of integration in each case.	
Be able to construct a differential equation using $F = ma$ and $a = \frac{dv}{dt}$ for a given situation, and solve using separation of variables.	