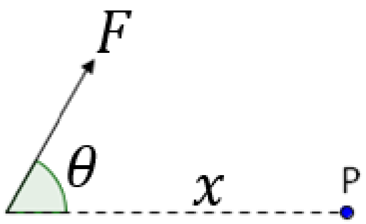
M2 Essentials: *Summary of AQA Mechanics 2 content not provided in the formula book*

Moments and equilibrium

$$Moment = Force \times Distance$$



$$M = -Fx\sin\theta$$

(note: an anti-clockwise moment is negative)

For a *rigid body* to be in equilibrium:

$$Resultant\ Force = 0$$
$$Resultant\ Moment = 0$$

Centre of mass

The point at which the mass, and hence weight, of an object can be thought to act. For uniform symmetrical shapes, this is always on any lines of symmetry.

$$\bar{x} = \frac{m_1x_1 + m_2x_2 + \cdots}{m_1 + m_2 + \cdots}$$

$$(Sum\ of\ the\ moments = Total\ moment)$$

Energy

Work Done (energy transferred):	$WD = Fx$
Kinetic Energy:	$KE = \frac{1}{2}mv^2$
Gravitational Potential Energy:	$GPE = mgh$
Elastic Potential Energy:	$EPE = \frac{\lambda e^2}{2l}$

Hooke's law

$$T = \frac{\lambda x}{l}$$

$T = tension\ (N)$ $\quad$ $\lambda = modulus\ of\ elasticity\ (N)$

$x = extension\ (m)$ $\quad$ $l = natural\ length\ (m)$

Proof of Elastic Potential Energy formula

$$T = \frac{\lambda x}{l} \implies Work\ Done\ by\ Tension = \int_0^e \frac{\lambda x}{l}\,dx = \left[\frac{\lambda x^2}{2l}\right]_0^e = \frac{\lambda e^2}{2l}$$

Power

Power is the *rate* of doing work (that is, the rate of transferring energy)

$$P = \frac{WD}{t} \qquad\qquad P = F_m v$$

$$P = power\ (W)$$

$WD = work\ done\ (J)$ $\quad$ $F_m = motive\ force\ (N)$

$t = time\ (s)$ $\quad$ $v = velocity\ (ms^{-1})$

Variable acceleration

$$v = \frac{dx}{dt} \quad\Big|\quad a = \frac{dv}{dt} = \frac{d^2x}{dt^2} \quad\Big|\quad x = \int v\,dt \quad\Big|\quad v = \int a\,dt$$

Circular motion

$$\omega = \frac{\theta}{t} \;\Big|\; T = \frac{2\pi}{\omega} \;\Big|\; v = r\omega \;\Big|\; a = r\omega^2 \;\Big|\; a = \frac{v^2}{r} \;\Big|\; F = mr\omega^2 \;\Big|\; F = \frac{mv^2}{r}$$

$\omega = Angular\ speed\ (rad\ s^{-1})$ $\quad$ $v = Speed\ (ms^{-1})$ $\quad$ $F = Centripetal\ force\ (N)$

$r = Radius\ (m)$

Differential equations

$$If\ a\ is\ a\ function\ of\ v\text{:}\quad a = \frac{dv}{dt} = f(v) \implies \int \frac{1}{f(v)}\,dv = \int 1\,dt$$