

REVISION SHEET – MECHANICS 2

CENTRE OF MASS (CoM)

The main ideas are

	AQA	Edx	MEI	OCR
Uniform bodies	M2	M2	M2	M2
Composite bodies	M2	M2	M2	M2
CoM when suspended	M2	M2	M2	-

Centre of Mass

In much of the work that you have done involving moments, the whole weight of a rigid body, such as a rod, was considered to act at its centre. This is called the centre of mass. However, if the rod did not have uniform distribution of its mass, then the centre of mass would be at a different location.

Uniform Bodies

For a uniform body:

Moment of the whole mass at the centre of mass
= sum of the moments of the individual masses

$$\text{i.e. } (\sum m)\bar{x} = \sum (mx)$$

A standard application of this method can be seen in the example to the right.

In examples using CoM it is always useful to check whether there is any symmetry present. (Although note that you should be careful to check that symmetry is actually present rather than assuming there is!)

For instance, in the example below, which is similar to the question to the right, it is possible to say that, by symmetry, the CoM will be at (5, 0).



Before the exam you should know:

- How to find the centre of mass of a system of particles of given position and mass.
- How to locate centre of mass by appeal to symmetry.
- How to find the centre of a mass of a composite body by considering each constituent part as a particle at its centre of mass.
- How to use the position of the centre of mass in problems involving the equilibrium of a rigid body.

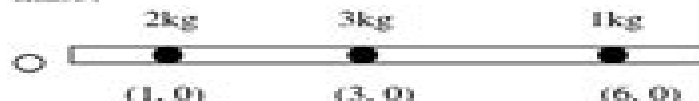
Example (CoM)

A rod A, of length 3 metres, has uniform mass. A rod B, also of length 3 metres, does not have uniform mass, with its mass concentrated towards one of its ends. For each rod, say whether it is possible to give the position of their CoM using the information given. If it is possible, state where the CoM is.

It can be clearly seen that for rod A the CoM acts half way along the rod, i.e. 1.5 m. However, for rod B, without further information you are unable to say where its CoM acts, except that because it is not uniformly distributed it will not lie in the centre.

Example (Uniform bodies)

Particles of mass 2kg, 3kg and 1kg are at the points (1, 0), (3, 0) and (6, 0) on a light rod which lies along the x -axis. What are coordinates of the centre of mass?



Relative to O:

$$\begin{aligned}
 (\sum m)\bar{x} &= \sum (mx) \\
 (2+3+1)\bar{x} &= (2 \times 1) + (3 \times 3) + (1 \times 6) \\
 6\bar{x} &= 15 \\
 \bar{x} &= \frac{15}{6} = \frac{5}{2} \\
 &= 2.5
 \end{aligned}$$

Therefore, the centre of mass lies at (2.5, 0).

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Christian Drosten



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