Mathematical Tripos Part IA

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Mechanics (non-examinable) Examples sheet 3

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On these sheets, no attempt is made to 'model' real-life situations: no trains, cars, cyclists, lifts, etc. It is assumed that there are no 'real' forces, such as air-resistance unless they are specifically mentioned. Most questions, but not all, avoid numbers and units, preferring general algebraic formulae with consistent dimensions.

1 Three particles of masses m_1 , m_2 and m_3 are fixed to a light rod at distances d_1 , d_2 and d_3 from one end. Find the distance of the centre of mass of the system from this end.

2 The density of a rod AB at a point x from A is $\mu x/l$ per unit length, where μ is a constant and l is the length of the rod. Find the mass of the rod and show that the centre of mass is a distance $\frac{2}{3}l$ from A.

3 A circular arc of radius *a* has constant density ρ per unit length and subtends an angle 2α at its centre. Show that its centre of mass is a distance $a \sin \alpha / \alpha$ from the centre.