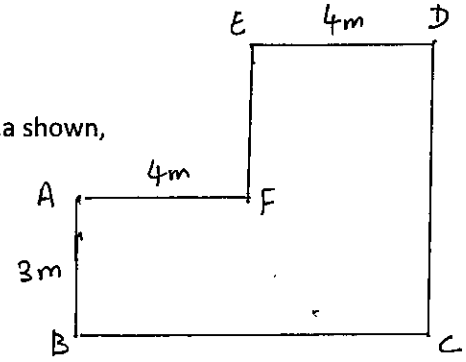
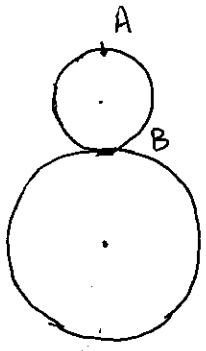
MI of Composite Bodies

1. Find the moment of inertia of the uniform L-shaped lamina shown, which has mass 3 kg, about the line AB. [80]



2. A rigid body consists of two uniform circular discs joined together at point B as shown. The radii of the discs are 1m and 2m. The mass of the small disc is M kg. Find the moment of inertia of the body about an axis through the point A and perpendicular to the plane containing the discs. $[73\frac{1}{2}]$

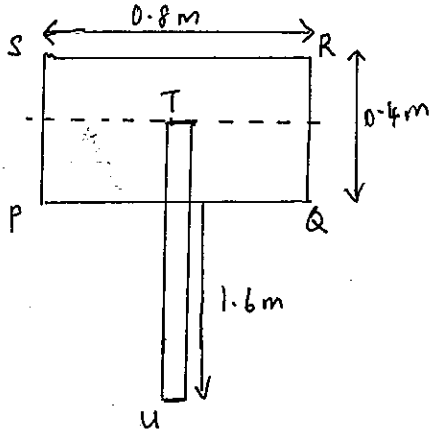


3. A uniform rod AB, of mass $2m$ and length $2l$ is rigidly attached to a uniform rod BC of mass m and length l in such a way that angle ABC is a right angle. Show that the MI of the frame ABC about an axis through B perpendicular to the plane of the frame is $3ml^2$.

4. Three thin uniform rods, each of mass M and length 2a are rigidly joined to form a framework in the shape of an equilateral triangle OPQ of side 2a. Find the MI of the framework about an axis through O perpendicular to the plane OPQ. $[6Ma^2]$

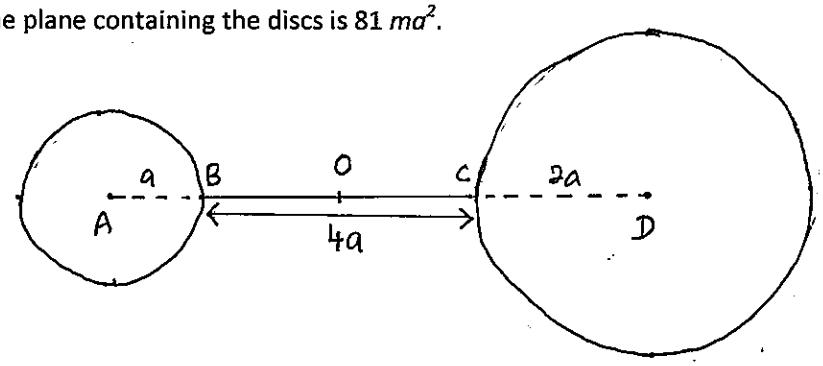
5. A compound pendulum consists of a uniform rod AB, of mass m and length 6a, is rigidly attached at B to a point on the circumference of a uniform circular lamina of mass m and radius 2a. The lamina and the line of the rod lie in the same vertical plane, with the centre of the lamina lying on the line of the rod produced. Find the MI about a horizontal axis through A perpendicular to the plane of the lamina. $[78Ma^2]$

6. A placard consists of a rectangular board, PQRS, of mass 2.4kg, where PQ=0.8m and QR=0.4m, attached to a pole, TU, of mass 1.5kg and length 1.8m. The pole is attached so that T is at the centre of PQRS and passes through the mid-point of PQ, as shown. Find the MI of the placard about the axis XY, where X and Y are the midpoints of QR and SP respectively. [1.652]

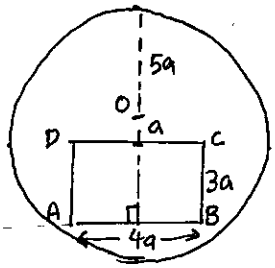


7. A uniform square lamina ABCD has mass 8kg and sides 4m. Two squares of edge 0.5m has been removed from the corner at A and C. Find the MI of the lamina about an axis through the midpoint of CD perpendicular to the plane of ABCD. $[50\frac{19}{24}]$

8. A rigid body consists of a uniform rod BC of mass $6m$ and length $4a$, rigidly attached at B and C to points on the circumferences of two uniform circular discs with centres A and D respectively. The disc with centre A has mass $2m$ and radius a. The disc with centre D has mass $3m$ and radius $2a$. The discs and the rod lie in the same plane and the points A,B,C and D are collinear (diagram). Show that the MI of the body about an axis through the centre O of the rod and perpendicular to the plane containing the discs is $81\ ma^2$.



9. A uniform rectangular plate ABCD, with AB=$4a$ and BC=$3a$ has mass $3M$. Find the MI of the plate about an axis through its centre of mass and perpendicular to its plane.
The plate ABCD is fixed to the surface of a uniform disc, of mass $10M$ and radius $5a$, in such a way that the perpendicular bisector of AB passes through the centre O of the disc. The perpendicular distances of CD and AB from O are a and $4a$ respectively (diagram). Show that the MI of the body about an axis through O perpendicular to the plane of the disc is $150Ma^2$.



10. A frame consists of three uniform rods, each of mass m and length $2a$, rigidly joined together to form triangle ABC, together with a uniform circular ring, of mass m, inscribed in a triangle. The ring is rigidly fixed to the rods AB, BC and CA at D, E and F respectively (diagram). Show that the MI of the frame about an axis through A perpendicular to the plane of the frame is $\frac{23}{3}\ ma^2$.