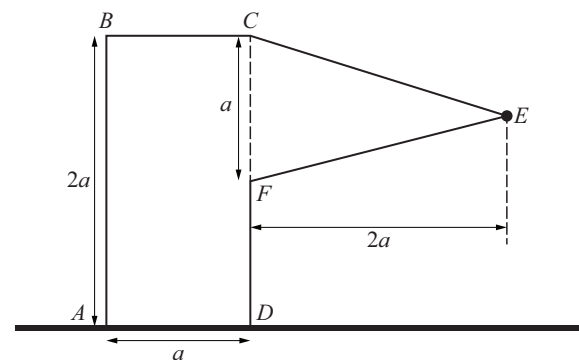


- 1 A particle P of mass m is attached to one end of a light inextensible string of length a . The other end of the string is attached to a fixed point O . The particle moves in a horizontal circle with constant angular speed ω and with the string inclined at an angle of θ to the downward vertical.

Given that $\tan \theta = \frac{4}{3}$, find ω in terms of a and g . [3]

4



An object consists of a uniform lamina with a particle attached. The uniform lamina $ABCEFD$ of mass m is formed from a rectangle $ABCD$ and an isosceles triangle CEF , where F is the midpoint of CD . The rectangle has sides $AB = 2a$ and $AD = a$. The triangle CEF has base a and height $2a$. The particle of mass km is attached to the lamina at E . The object rests in a vertical plane with its edge AD on horizontal ground (see diagram).

Given that the object is on the point of toppling in its vertical plane about the vertex D , find the value of k . [4]

- Two uniform smooth spheres A and B of equal radii have masses $4m$ and m respectively. Sphere B is at rest on a smooth horizontal surface. Sphere A is moving on the surface with speed u and collides directly with sphere B . After the collision, the momentum of A is three times the momentum of B .

Find the value of the coefficient of restitution e .

[4]

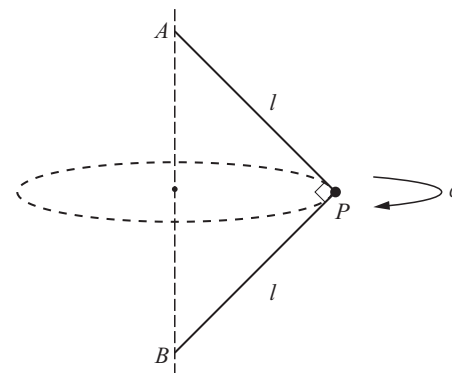
- 2 A particle P of mass m is moving in a horizontal circle with angular speed ω_1 on the smooth inner surface of a hemispherical shell of radius r . The angle between the upward vertical and the normal reaction of the surface on P is θ_1 , where $\tan \theta_1 = \frac{3}{4}$.

When the angular speed is increased to ω_2 , the angle between the upward vertical and the normal reaction of the surface on P becomes θ_2 , where $\tan \theta_2 = \frac{4}{3}$.

Find the ratio $\frac{\omega_1}{\omega_2}$.

[4]

- 1 A particle P of mass m is attached to two light inextensible strings each of length l . The end of one string is attached to a fixed point A and the end of the other string is attached to a fixed point B , with A vertically above B . Angle APB is a right angle. The particle P rotates in a horizontal circle at a constant angular speed ω with both strings taut (see diagram).



Find the tension in string AP in terms of m , g , l and ω .

[4]