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4. (a) Use algebraic integration to show that the centre of mass of a uniform solid hemisphere of radius a is a distance $\frac{3}{8}a$ from the centre of its plane face.

[*You may assume that the volume of a sphere of radius r is* $\frac{4}{3}\pi r^3$]

(5)

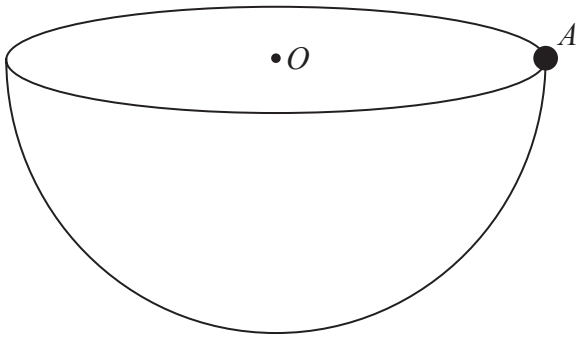


Figure 4

A uniform solid hemisphere has mass m and radius a. A particle of mass km is attached to a point A on the circumference of the plane face of the hemisphere to form the loaded solid S. The centre of the plane face of the hemisphere is the point O, as shown in Figure 4.

The loaded solid S is placed on a horizontal plane. The curved surface of S is in contact with the plane and S rests in equilibrium with OA making an angle α with the horizontal, where $\tan\alpha = \sqrt{3}$

(b) Find the exact value of k.

(5)

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Q4