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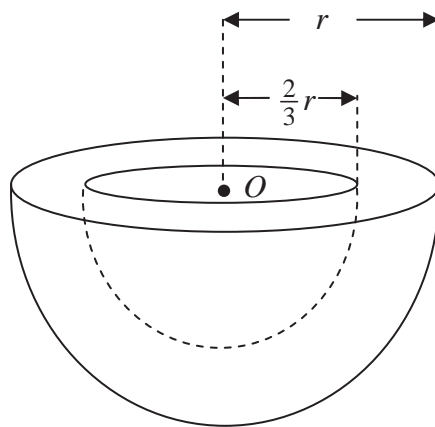


Figure 1

A bowl  $B$  consists of a uniform solid hemisphere, of radius  $r$  and centre  $O$ , from which is removed a solid hemisphere, of radius  $\frac{2}{3}r$  and centre  $O$ , as shown in Figure 1.

- (a) Show that the distance of the centre of mass of  $B$  from  $O$  is  $\frac{65}{152}r$ . (5)

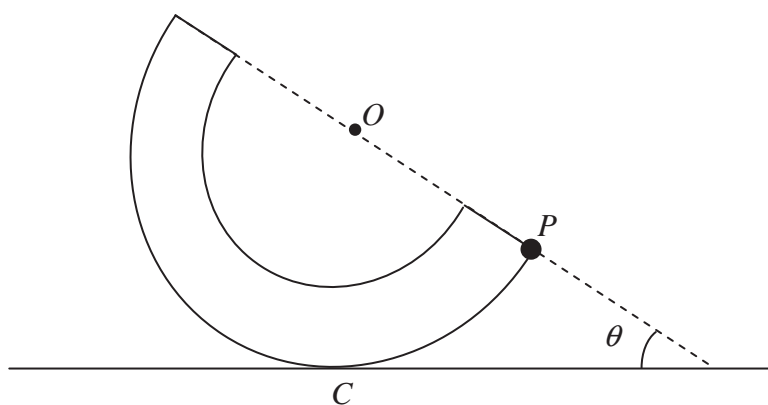


Figure 2

The bowl  $B$  has mass  $M$ . A particle of mass  $kM$  is attached to a point  $P$  on the outer rim of  $B$ . The system is placed with a point  $C$  on its outer curved surface in contact with a horizontal plane. The system is in equilibrium with  $P$ ,  $O$  and  $C$  in the same vertical plane. The line  $OP$  makes an angle  $\theta$  with the horizontal as shown in Figure 2. Given that

$$\tan \theta = \frac{4}{5},$$

- (b) find the exact value of  $k$ . (5)

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