3.

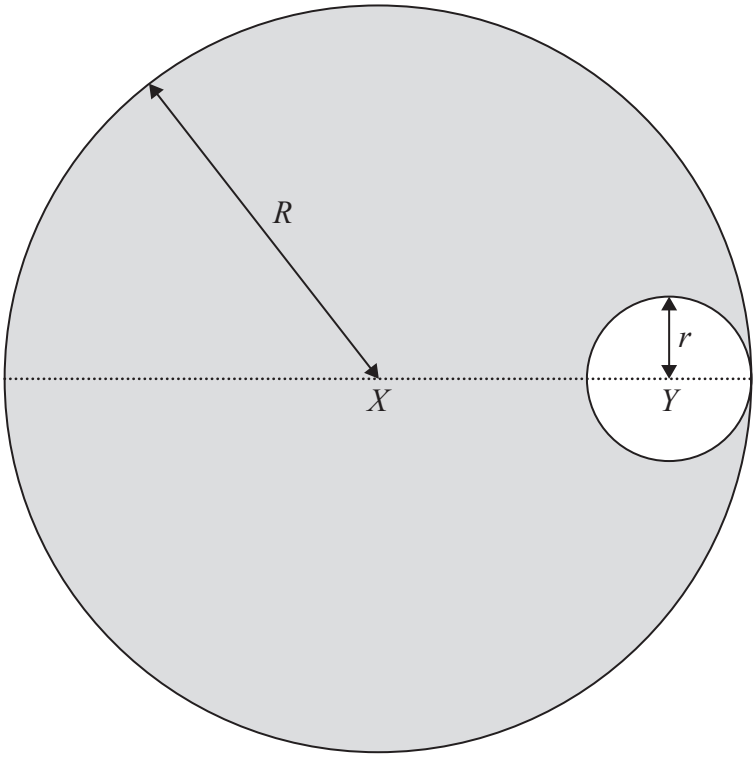


Figure 1

A uniform circular disc C has centre X and radius R.

A disc with centre Y and radius r, where $0 < r < R$ and $XY = R - r$, is removed from C to form the template shown shaded in Figure 1.

The centre of mass of the template is a distance kr from X.

(a) Show that $r = \dfrac{k}{1-k}R$

(4)

(b) Hence find the range of possible values of k.

(2)

The point P is on the outer edge of the template and PX is perpendicular to XY.

The template is freely suspended from P and hangs in equilibrium.

Given that $k = \dfrac{4}{9}$

(c) find the angle that XY makes with the vertical.

(3)

The mass of the template is M.

(d) Find, in terms of M, the mass of the lightest particle that could be attached to the template so that it would hang in equilibrium from P with XY horizontal.

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 3 continued

Question 3 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 3 continued

(Total for Question 3 is 12 marks)