Leave blank

4.

[*The centre of mass of a uniform semicircular lamina of radius r is* $\frac{4r}{3\pi}$ *from the centre.*]

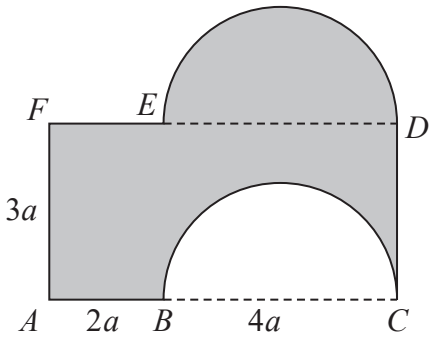


Figure 3

The uniform rectangular lamina $ABCDEF$ has sides $AC = FD = 6a$ and $AF = CD = 3a$. The point B lies on AC with $AB = 2a$ and the point E lies on FD with $FE = 2a$.

The template, T, shown shaded in Figure 3, is formed by removing the semicircular lamina with diameter BC from the rectangular lamina and then fixing this semicircular lamina to the opposite side, FD, of the rectangular lamina. The diameter of the semicircular lamina coincides with ED and the semicircular arc ED is outside the rectangle $ABCDEF$. All points of T lie in the same plane.

(a) Show that the centre of mass of T is a distance $\left(\frac{9 + 2\pi}{6}\right)a$ from AC.

(4)

The mass of T is M. A particle of mass kM is attached to T at C. The loaded template is freely suspended from A and hangs in equilibrium with AF at angle ϕ to the downward vertical through A.

Given that $\tan\phi = \frac{3}{2}$

(b) find the value of k.

(6)

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

Leave blank

Question 4 continued

Leave blank

Question 4 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

Leave blank

Question 4 continued

Q4

(Total 10 marks)