2. [*In this question you may use, without proof, the formula for the centre of mass of a uniform sector of a circle.*]

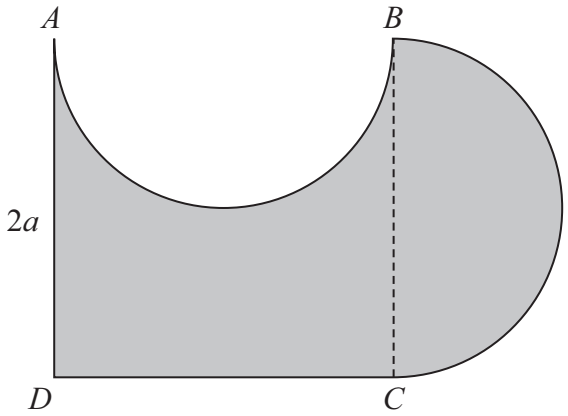


Figure 1

A uniform square lamina $ABCD$ has side $2a$.

A semicircular lamina, with diameter AB, is removed from the square lamina.

The semicircular lamina is then attached to BC to form the uniform lamina L shown shaded in Figure 1.

The centre of mass of L is a distance $\overline{x}$ from AD.

(a) Show that

$$\overline{x} = \frac{a}{24}(28 + 3\pi)$$

(5)

The lamina L has weight W.
A particle of weight kW is attached to L at D to form a loaded lamina.

The loaded lamina is now suspended by two light vertical strings with the first string attached at A and the second string attached at B.

The loaded lamina hangs freely in equilibrium with DC horizontal.

Given that the tension in the string attached at A is $4T$ and the tension in the string attached at B is T

(b) find the exact value of k.

(5)

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Question 2 continued

(Total for Question 2 is 10 marks)