4. [*In this question you may use, without proof, the formula for the centre of mass of a circular arc.*]

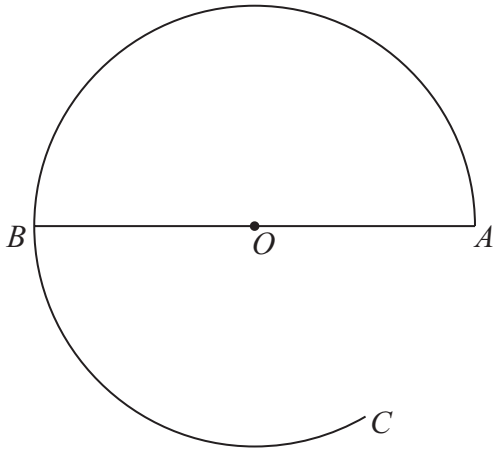


Figure 1

Uniform wire is used to form the **framework** $BOAC$ shown in Figure 1.

In the framework

- BOA is straight and has length $2a$
- ABC is a circular arc of radius a with centre O
- angle $COA = \frac{\pi}{3}$ radians
- the points B, O, A, C and the framework all lie in the same plane

The perpendicular distance of the centre of mass of the framework from BA is $\bar{y}$.

(a) Show that

$$\bar{y} = \frac{3a}{2(5\pi + 6)}$$

(6)

The framework is freely suspended from B and hangs in equilibrium with AB at an angle $\theta°$ to the downward vertical.

(b) Find the value of θ, giving your answer to one decimal place.

(5)

(Total for Question 4 is 11 marks)