4.

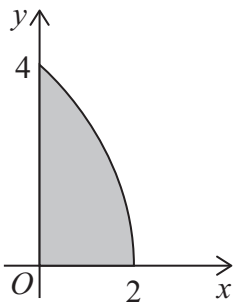


Figure 3

The shaded region shown in Figure 3 is bounded by the positive x-axis, the positive y-axis and the curve with equation $(x + 3)^2 + y^2 = 25$

The unit of length on both of the axes is 1 m.

The shaded region is rotated through 2π radians about the x-axis to form a solid of revolution which is used to model a uniform solid S.

The volume of S is $\frac{52}{3}\pi \text{m}^3$

(a) Show, using **algebraic integration**, that the centre of mass of S is $\frac{9}{13}$ m from O.

(6)

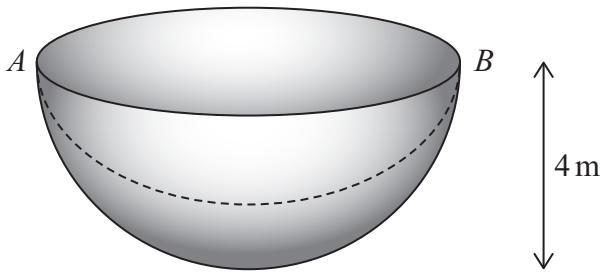


Figure 4

A solid T, which is the same size and shape as S, is **removed** from a uniform solid hemisphere of radius 4 m. The plane face of T is the plane face of the hemisphere.

The solid remaining is in the shape of a bowl, shown in Figure 4, where A and B are points on the circular rim of the bowl and AB is a diameter of the rim.

The centre of mass of the bowl is d metres from the midpoint of AB.

(b) Show that $d = \frac{39}{19}$

(4)

The bowl is now suspended from A and hangs freely in equilibrium with AB at $\theta°$ to the downward vertical.

(c) Find the value of θ

(2)

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Question 4 continued

(Total for Question 4 is 12 marks)