

13.

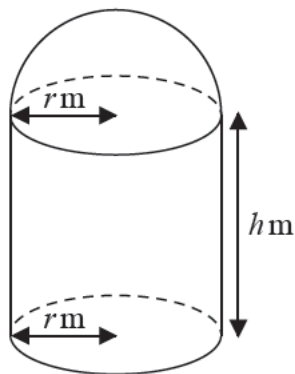


Figure 9

[A sphere of radius  $r$  has volume  $\frac{4}{3}\pi r^3$  and surface area  $4\pi r^2$ ]

A manufacturer produces a storage tank.

The tank is modelled in the shape of a hollow circular cylinder closed at one end with a hemispherical shell at the other end as shown in Figure 9.

The walls of the tank are assumed to have negligible thickness.

The cylinder has radius  $r$  metres and height  $h$  metres and the hemisphere has radius  $r$  metres.

The volume of the tank is  $6\text{ m}^3$ .

(a) Show that, according to the model, the surface area of the tank, in  $\text{m}^2$ , is given by

$$\frac{12}{r} + \frac{5}{3}\pi r^2 \quad (4)$$

The manufacturer needs to minimise the surface area of the tank.

(b) Use calculus to find the radius of the tank for which the surface area is a minimum. (4)

(c) Calculate the minimum surface area of the tank, giving your answer to the nearest integer. (2)