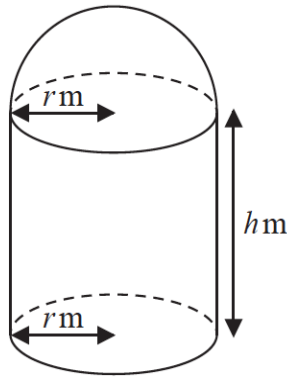


13.



**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  $5.4 \text{ m}^3$ .

(a) Find the surface area of the exterior of the tank in terms of  $r$ .

(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. Give your answer to 3 significant figures if necessary.

(4)

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

(2)

**(Total for Question 13 is 10 marks)**