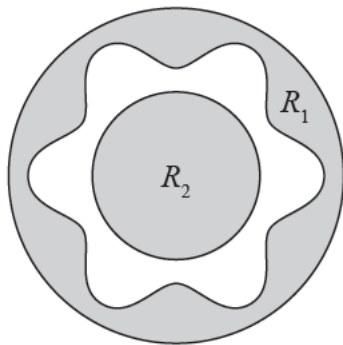


3.



**Figure 1**

Figure 1 shows the design for a new type of security wheel nut for a car. The inner circle has a radius of 5 mm and the outer circle has a radius of 10 mm. The curve,  $C$ , between the two circles, is modelled by the polar equation

$$r = 7.5 + 1.5 \cos 6\theta \quad 0 \leq \theta < 2\pi$$

where  $r$  is measured in millimetres.

The regions  $R_1$  and  $R_2$  are shown shaded in Figure 1 and both regions must be coated in a special paint.

The region  $R_1$  is enclosed between the outer circle and  $C$ .

The region  $R_2$  is enclosed by the inner circle.

Find the area that must be coated in the special paint, according to the model.

Give your answer in  $\text{cm}^2$  to 2 decimal places.

[Solutions based entirely on graphical or numerical methods are not acceptable.]