

7.1 Polar Coordinates

7.1.1 Polar Coordinates / 7.1.2 Calculus with Polar Coordinates

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Total Marks

/41

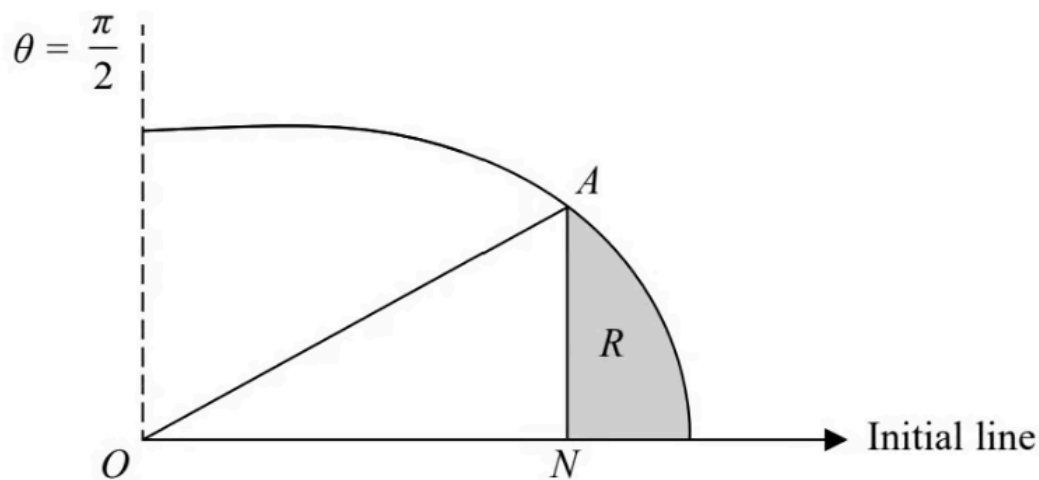


Figure 1

- 1 The curve C shown in Figure 1 has polar equation

$$r = 4 + \cos 2\theta \quad 0 \leq \theta \leq \frac{\pi}{2}$$

At the point A on C , the value of r is $\frac{9}{2}$

The point N lies on the initial line and AN is perpendicular to the initial line.

The finite region R , shown shaded in Figure 1, is bounded by the curve C , the initial line and the line AN .

Find the exact area of the shaded region R , giving your answer in the form $p\pi + q\sqrt{3}$ where p and q are rational numbers to be found.

(9 marks)

- 2 (a)** (a) (i) Show on an Argand diagram the locus of points given by the values of z satisfying

$$|z - 4 - 3i| = 5$$

Taking the initial line as the positive real axis with the pole at the origin and given that

$$\theta \in [\alpha, \alpha + \pi], \text{ where } \alpha = -\arctan\left(\frac{4}{3}\right),$$

- (ii) show that this locus of points can be represented by the polar curve with equation

$$r = 8 \cos\theta + 6 \sin\theta$$

(6 marks)

- (b)** The set of points A is defined by

$$A = \left\{ z : 0 \leq \arg z \leq \frac{\pi}{3} \right\} \cap \{ z : |z - 4 - 3i| \leq 5 \}$$

- (b) (i) Show, by shading on your Argand diagram, the set of points A .
- (ii) Find the **exact** area of the region defined by A , giving your answer in simplest form.

(7 marks)

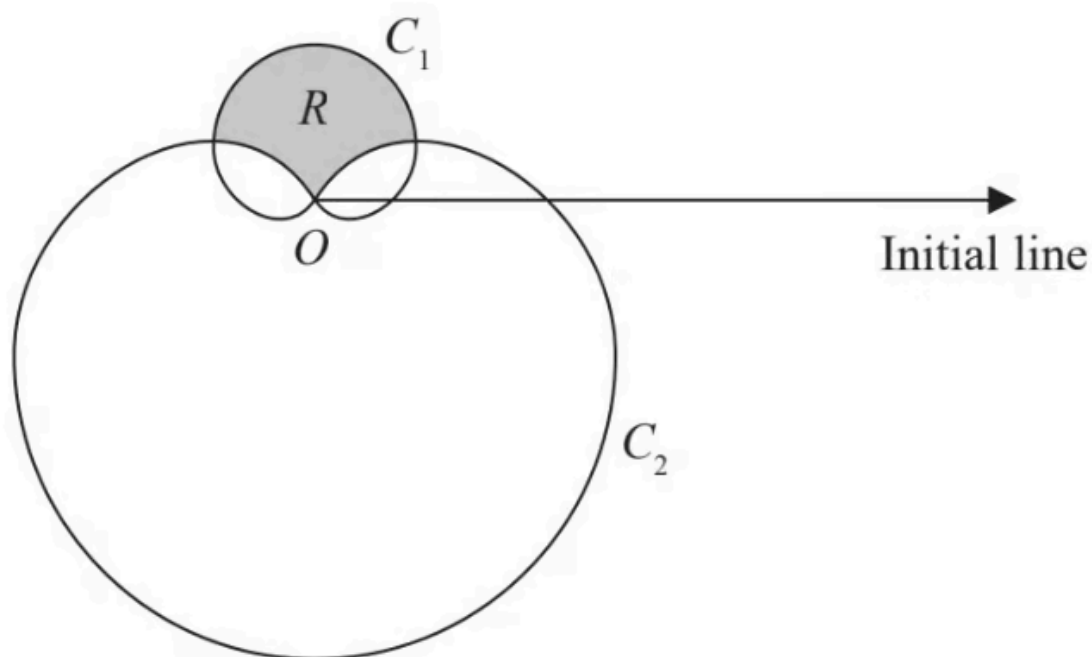


Figure 1

3 Figure 1 shows a sketch of two curves C_1 and C_2 with polar equations

$$C_1: r = (1 + \sin \theta) \quad 0 \leq \theta < 2\pi$$

$$C_2: r = 3(1 - \sin \theta) \quad 0 \leq \theta < 2\pi$$

The region R lies inside C_1 and outside C_2 and is shown shaded in Figure 1.

Show that the area of R is

$$p\sqrt{3} - q\pi$$

where p and q are integers to be determined.

(9 marks)

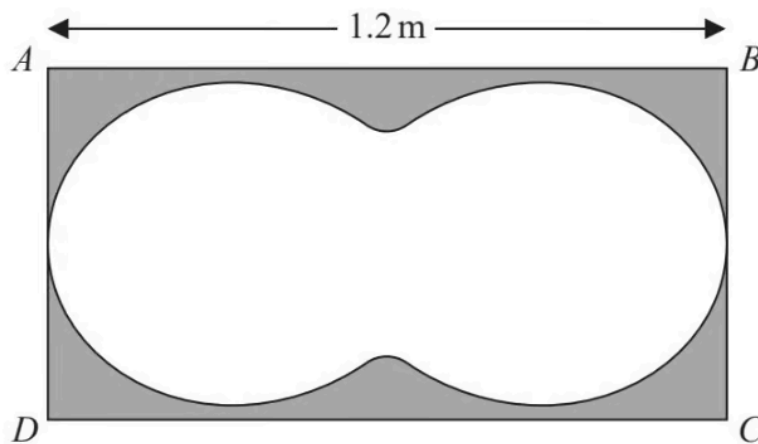


Diagram not
to scale

Figure 1

- 4 (a)** Figure 1 shows the design for a table top in the shape of a rectangle $ABCD$. The length of the table, AB , is 1.2 m. The area inside the closed curve is made of glass and the surrounding area, shown shaded in Figure 1, is made of wood.

The perimeter of the glass is modelled by the curve with polar equation

$$r = 0.4 + a \cos 2\theta \quad 0 \leq \theta < 2\pi$$

where a is a constant.

- a) Show that $a = 0.2$

(2 marks)

- (b)** Hence, given that $AD = 60$ cm,

- (b) find the area of the wooden part of the table top, giving your answer in m^2 to 3 significant figures.

(8 marks)