

# 1.5 Polar coordinates

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_ **Total: 16 marks**

**KEY WORDS** polar coordinates 极坐标 • polar curves 极坐标曲线  
• cartesian coordinates 直角坐标

## Objective

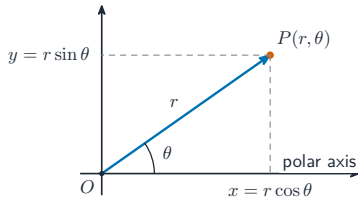
Build the skills to answer exam questions on **polar coordinates** 极坐标 — converting to/from Cartesian, sketching **polar curves** 极坐标曲线, and the **sector area**  $\frac{1}{2} \int r^2 d\theta$ .

**You must be able to:**

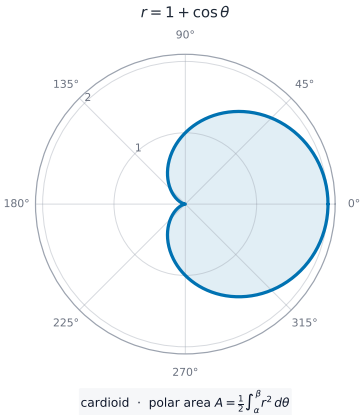
- convert between  $(r, \theta)$  and  $(x, y)$
- sketch a simple polar curve (e.g. a cardioid)
- find an area with  $\frac{1}{2} \int r^2 d\theta$

## 1 Worked examples

### ■ Conversion & area



$$x = r \cos \theta, y = r \sin \theta, r^2 = x^2 + y^2$$



*Polar curves are traced as the angle varies*

**Convert**  $r = 4 \cos \theta$ :  $\times r \rightarrow r^2 = 4r \cos \theta$ , so  $x^2 + y^2 = 4x$ , i.e.  $(x - 2)^2 + y^2 = 4$  (circle).

**Area:**  $A = \frac{1}{2} \int_{\alpha}^{\beta} r^2 d\theta$ .

## 2 Practice

**2.1** Convert the point  $(r, \theta) = (2, \frac{\pi}{3})$  to Cartesian coordinates. [2]

**2.2** Write down the formula for the area of a polar sector. [1]

## 3 Exam-style questions

**3.1** The polar equation  $r = 2 \sin \theta$  represents: [1]

- |   |   |
|---|---|
| A | B |
| C | D |
- A a line  
B a circle  
C a parabola  
D a spiral

**3.2** A curve has polar equation  $r = 3 + 2 \cos \theta$  for  $0 \leq \theta < 2\pi$  (a convex limaçon).

(a) Write down the greatest and least values of  $r$ , and state the value of  $\theta$  at which each occurs. Explain why the curve never passes through the pole. [3]

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(b) Show that the area enclosed by the curve is  $11\pi$ . [5]

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**3.3** Convert  $r = \frac{2}{1 + \cos \theta}$  to Cartesian form. [4]

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