# Polar coordinates and curves

Answers

**Further Maths topic practice**

This topic online

| Q | Answer | Marks |
|---|---|---|
| 1 | **a)** (-2, 2√3) **b)** B(5√2, 3π/4), C(4, 11π/6) | 4 |
| 2 | **a)** r = 6cos θ **b)** r = 4sec θ **c)** $r^2$ = 8cosec 2θ | 5 |
| 3 | **a)** $x^2 + (y - 2)^2 = 4$: a circle with centre (0, 2) and radius 2<br>**b)** x + y = 2: a straight line with gradient -1 through (2, 0) and (0, 2) | 5 |
| 4 | A cardioid with its cusp at the pole (θ = π/2), symmetrical about θ = π/2, through (3, 0) and (3, π), and furthest from the pole at (6, 3π/2) | 3 |
| 5 | **a)** Spiral starting at O, turning anticlockwise, through (3π/2, π/2), (3π, π), (9π/2, 3π/2) and ending at (6π, 2π) on the initial line<br>**b)** (-2π, -2√3π) | 5 |
| 6 | **a)** For π/3 < θ < 2π/3, π < 3θ < 2π so sin 3θ < 0 and r < 0, which is not allowed<br>**b)** 0 ≤ θ ≤ π/3, 2π/3 ≤ θ ≤ π, 4π/3 ≤ θ ≤ 5π/3<br>**c)** Three equal loops meeting at the pole, tips at (3, π/6), (3, 5π/6) and (3, 3π/2) | 6 |
| 7 | **a)** C1 is an egg shape (no dimple) through r = 8 at θ = 0, r = 6 at θ = π/2 and 3π/2, r = 4 at θ = π; C2 is a circle centre O radius 5<br>**b)** (5, 2π/3) and (5, 4π/3) | 6 |
| 8 | **a)** 0 ≤ θ ≤ π/4, 3π/4 ≤ θ ≤ 5π/4, 7π/4 ≤ θ < 2π<br>**b)** Figure of eight: two loops meeting at the pole with tangents θ = ±π/4 there, furthest points (3, 0) and (3, π)<br>**c)** $r^4 = 9r^2 \cos 2\theta = 9(r^2 \cos^2\theta - r^2 \sin^2\theta)$, so $(x^2 + y^2)^2 = 9(x^2 - y^2)$ | 6 |
| 9 | **a)** $(x - 1)^2 + (y - 2)^2 = 5$: centre (1, 2), radius √5<br>**b)** Circle through the pole, centre (1, 2), radius √5 **c)** r = 2√5 when θ = 1.11 | 8 |
| 10 | **a)** C1: cardioid through (1, 0), (2, π/2), (1, π) with its cusp at the pole (θ = 3π/2); C2: circle above the initial line through O with diameter 3 along θ = π/2<br>**b)** (3/2, π/6) and (3/2, 5π/6)<br>**c)** y = r sin θ = 3/2 × 1/2 = 3/4 for both; distance 3√3/2 | 8 |
| 11 | **a)** greatest 3 m at θ = 0, 2π/3, 4π/3; least 1 m **b)** 4 m **c)** 3√3 = 5.20 m | 7 |
| 12 | **a)** r sin θ × ½ + r cos θ × √3/2 = 3 gives y/2 + √3x/2 = 3, so √3x + y = 6<br>**b)** (3, π/6)<br>**c)** Circle centre O radius 4; line crossing the initial line at x = 2√3 and θ = π/2 at y = 6, cutting the circle twice<br>**d)** 2√7 **e)** (4, 1.25) and (4, 6.08) | 9 |


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Full worked solutions, written out by hand, are on the solutions sheet for this topic.


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