1. If $r = \theta - 3\sin\theta$ then $\dfrac{dr}{d\theta}$ at (π, π) is

(A) 2 (B) π (C) 4 (D) 2π

2. If $r = \dfrac{2}{1-\cos\theta}$ then $\dfrac{dr}{d\theta}$ at $(2, \dfrac{\pi}{2})$ is

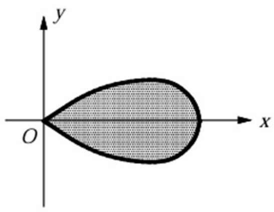
(A) -2 (B) -1 (C) 0 (D) 1

3. If $r = 3\sin\theta$ then $\dfrac{dy}{dx}$ at the point where $\theta = \dfrac{\pi}{3}$ is

(A) -2 (B) $-\sqrt{3}$ (C) -1 (D) $\dfrac{\sqrt{3}}{3}$

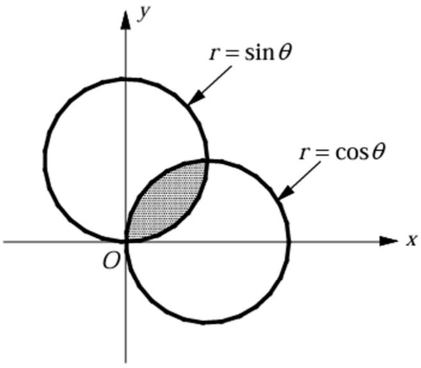
1. The area of the region enclosed by the polar curve $r^2 = 6\sin(2\theta)$ is

(A) 2 (B) 4 (C) 6 (D) 12



2. What is the area of the region enclosed by the loop of the graph of the polar curve $r = 2\cos(2\theta)$ shown in the figure above?

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{2}$ (C) $\frac{3\pi}{4}$ (D) π



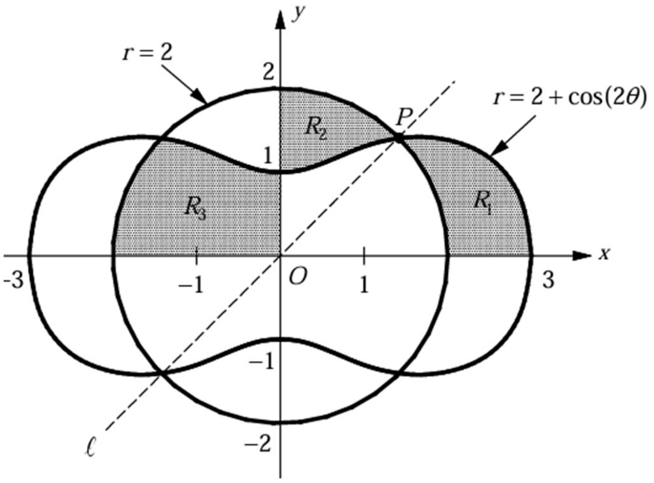
3. The area of the shaded region that lies inside the polar curves $r = \sin\theta$ and $r = \cos\theta$ is

(A) $\frac{1}{8}(\pi - 2)$ (B) $\frac{1}{4}(\pi - 2)$ (C) $\frac{1}{2}(\pi - 2)$ (D) $\frac{1}{8}(\pi - 1)$

4. The area of the region enclosed by the polar curve $r = 2 + \sin\theta$ is

(A) 3π (B) $\frac{7\pi}{2}$ (C) 4π (D) $\frac{9\pi}{2}$

5.



The figure above shows the graphs of the polar curves $r = 2 + \cos(2\theta)$ and $r = 2$. Let R_1 be the shaded region in the first quadrant bounded by the two curves and the x-axis, and R_2 be the shaded region in the first quadrant bounded by the two curves and the y-axis. The graphs intersect at point P in the first quadrant.

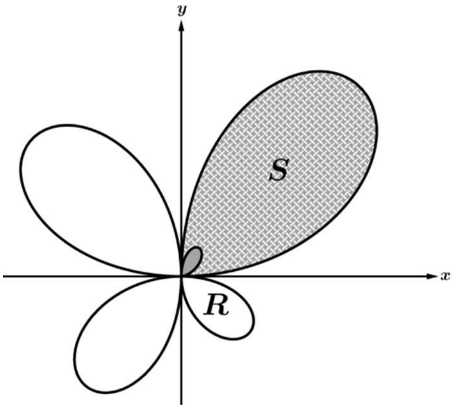
(a) Find the polar coordinates of point P and write the polar equation for the line ℓ.

(b) Set up, but do not integrate, an integral expression that represents the area of R_1.

(c) Set up, but do not integrate, an integral expression that represents the area of R_2.

(d) Let R_3 be the shaded region in the second quadrant bounded by the two curves and the coordinate axis. Find the area of R_3.

(e) The distance between the two curves changes for $0 < \theta < \dfrac{\pi}{4}$. Find the rate at which the distance between the two curves is changing with respect to θ when $\theta = \dfrac{\pi}{6}$.



6.

The graph of the polar curve $r(\theta) = \theta\sin(\theta)\cos(\theta)$ is shown in the figure above for $0 \le \theta \le \frac{5\pi}{2}$. Let S be the shaded region in the outer loop of the graph of $r(\theta)$ and also outside of the inner loop of $r(\theta)$, as shown in the figure above. Let R be the region bounded by the graph of $r(\theta)$ in quadrant IV, as shown in the figure.

a. Find the area of S.

b. Find the area of R.

c. For $\frac{\pi}{2} < \theta < \frac{3\pi}{4}$, $r(\theta) < 0$ and $\frac{dr}{d\theta} < 0$. What do these facts say about the curve relative to the origin?