

## Chapter 10 FRQ Classwork

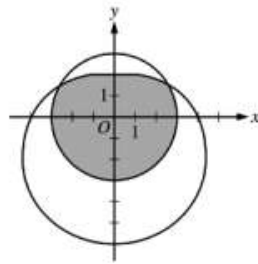
1.

At time  $t \geq 0$ , a particle moving along a curve in the  $xy$ -plane has position  $(x(t), y(t))$  with velocity vector  $v(t) = (\cos(t^2), e^{0.5t})$ . At  $t = 1$ , the particle is at the point  $(3, 5)$ .

- Find the  $x$ -coordinate of the position of the particle at time  $t = 2$ .
- For  $0 < t < 1$ , there is a point on the curve at which the line tangent to the curve has a slope of 2. At what time is the object at that point?
- Find the time at which the speed of the particle is 3.
- Find the total distance traveled by the particle from time  $t = 0$  to time  $t = 1$ .

2.

The graphs of the polar curves  $r = 3$  and  $r = 4 - 2\sin \theta$  are shown in the figure above. The curves intersect when  $\theta = \frac{\pi}{6}$  and  $\theta = \frac{5\pi}{6}$ .



- Let  $S$  be the shaded region that is inside the graph of  $r = 3$  and also inside the graph of  $r = 4 - 2\sin \theta$ . Find the area of  $S$ .
- A particle moves along the polar curve  $r = 4 - 2\sin \theta$  so that at time  $t$  seconds,  $\theta = t^2$ . Find the time  $t$  in the interval  $1 \leq t \leq 2$  for which the  $x$ -coordinate of the particle's position is  $-1$ .
- For the particle described in part (b), find the position vector in terms of  $t$ . Find the velocity vector at time  $t = 1.5$ .

3.

A particle is moving along a curve so that its position at time  $t$  is  $(x(t), y(t))$ , where  $x(t) = t^2 - 4t + 8$  and  $y(t)$  is not explicitly given. Both  $x$  and  $y$  are measured in meters, and  $t$  is measured in seconds. It is known that  $\frac{dy}{dt} = te^{t-3} - 1$ .

- Find the speed of the particle at time  $t = 3$  seconds.
- Find the total distance traveled by the particle for  $0 \leq t \leq 4$  seconds.
- Find the time  $t$ ,  $0 \leq t \leq 4$ , when the line tangent to the path of the particle is horizontal. Is the direction of motion of the particle toward the left or toward the right at that time? Give a reason for your answer.
- There is a point with  $x$ -coordinate 5 through which the particle passes twice. Find each of the following.
  - The two values of  $t$  when that occurs
  - The slopes of the lines tangent to the particle's path at that point
  - The  $y$ -coordinate of that point, given  $y(2) = 3 + \frac{1}{e}$

4.

The graph of the polar curve  $r = 1 - 2\cos \theta$  for  $0 \leq \theta \leq \pi$  is shown above. Let  $S$  be the shaded region in the third quadrant bounded by the curve and the  $x$ -axis.

- Write an integral expression for the area of  $S$ .
- Write expressions for  $\frac{dx}{d\theta}$  and  $\frac{dy}{d\theta}$  in terms of  $\theta$ .
- Write an equation in terms of  $x$  and  $y$  for the line tangent to the graph of the polar curve at the point where  $\theta = \frac{\pi}{2}$ . Show the computations that lead to your answer.

