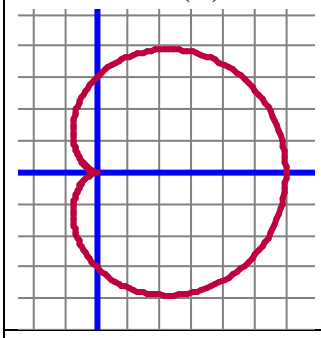
BC Calculus
10-#7 Polar Functions – Derivatives

Name: _____
Period: _____

1. Use the function and the graph shown to answer the question and explain the meaning of the results.

$r = 3 + 3\cos(\theta)$



a) Find $\frac{dr}{d\theta}$

b) Find $\frac{dr}{d\theta}$ at $\theta = \frac{3\pi}{2}$ and explain what it means graphically.

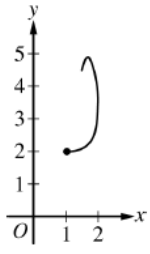
c) Find the parametric form of the polar function.

d) Find $\frac{dx}{d\theta}$. Also find $\left.\frac{dx}{d\theta}\right|_{\theta=\frac{3\pi}{2}}$ and explain what it means graphically.

e) Find $\frac{dy}{dx}$ and $\left.\frac{dy}{dx}\right|_{\theta=\frac{3\pi}{2}}$ What does this mean graphically? Show on the graph.

2. Parametric Practice: Calculator required.

A particle moving in the xy-plane has position $(x(t), y(t))$ at time $t \geq 0$, where $\frac{dx}{dt} = \cos\left(t^2\right)$ and $\frac{dy}{dt} = e^t \sin\left(t^2\right)$. At time $t = 0$, the particle is at position $(1, 2)$. The figure above shows the path of particle for $0 \leq t \leq 2$.

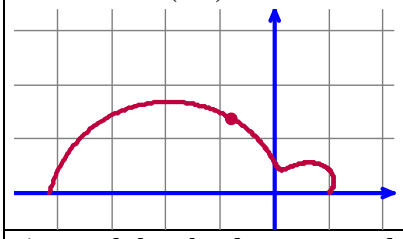


(a) Find the position of the particle at time $t = 2$.

(b) Find the slope of the line tangent to the particle's path at time $t = 2$.

(c) Find the speed of the particle at time $t = 2$. Find the acceleration vector of the particle at time $t = 2$.

(d) Consider a rectangle with vertices at points $(0, 0)$, $(x(t), 0)$, $(x(t), y(t))$, and $(0, y(t))$ at time $t \geq 0$. For $0 \leq t \leq 2$, at what time t is the perimeter of the rectangle a maximum? Justify your answer.

3. Use the function and the graph shown to answer the question and explain the meaning of the results. $r = \theta + \cos(2\theta)$ for $0 \le \theta \le \pi$ 	a) Find $\frac{dr}{d\theta}$	b) Make a sign chart for $\frac{dr}{d\theta}$
c) Find the absolute min and max of r on $0 \le \theta \le \pi$ by checking the endpoints and the critical points. *use a calculator for y-values.	d) Find equations for $x(\theta)$ and $y(\theta)$	e) $\left.\frac{dx}{d\theta}\right\|_{\theta=\frac{2\pi}{3}} < 0$. What does this tell you about the curve at the point marked? f) Is $\left.\frac{dy}{d\theta}\right\|_{\theta=\frac{2\pi}{3}}$ positive or negative? Why?

4. For each of the following, find $\frac{dy}{dx}$ at the given value of θ. Answers jumbled: $-\sqrt{3}, \frac{1}{2}, \frac{\pi}{2}, 1, 0, -1$

a) $r = 2 + 3\sin\theta,\ \theta = \frac{3\pi}{2}$	b) $r = 4\sin\theta,\ \theta = \frac{\pi}{3}$
c) $r = 2\theta^2$, $\theta = \pi$	d) $r = 2\sin(3\theta),\ \theta = \frac{\pi}{4}$