NAME: ID#:

SHOW ALL YOUR WORK

1. **(4pts)** Change to rectangular coordinates: $(i)\ (5, 2\pi/3),\quad (ii)\ (-5, -\pi/6)\,.$

2. **(6pts)** Express

   (a) $x^2\left(x^2 + y^2\right) = y^2$ as a polar equation and simplify your answer.

   (b) $\theta = \frac{\pi}{4}$ as a Cartesian equation and simplify your answer..

3. **(4pts)** Find all points of intersection of the line $y = x$ and the cardoid $r = 1 + \cos\theta$.

4. **(5pts)** Compute $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for $x = \sin t$ and $y = \cos 2t$ at $t = \pi/3$.

5. **(6pts)** Find the equation of the tangent line to the graph of $r = 2\cos\theta$ at $\theta = \pi/4$.

6. **(5pts)** Calculate the length of the polar curve $r = \sin^2\left(\frac{\theta}{2}\right)$ from $\theta = 0$ to $\theta = \pi$.

7. **(5pts)** Set up an integral to calculate the area common between the two cardoids $r = 1 + \cos\theta$ and $r = 1 - \cos\theta$. Do not integrate.

8. **(5pts)** Find the area of the surface generated by revolving the curve $r = \cos\theta$ about the line $\theta = \pi/2$.