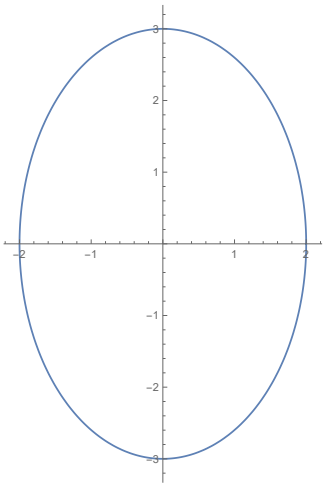
Exam 4b **Calculus 2** **4/19/24**

Each problem is worth 10 points. For full credit provide good justification for your answers.

1. (a) Convert the point with rectangular coordinates $(-3, 3)$ to polar coordinates (r, θ).

(b) Convert the point with polar coordinates $(5, 2\pi)$ to rectangular coordinates.

2. Find an equation for the ellipse shown:



3. Write an integral for the length of one arch of the cycloid with parametric equations $x(t) = 3(t - \sin t), y(t) = 3(1 - \cos t)$

4. Write an integral for the area under one arch of the cycloid with parametric equations $x(t) = 3(t - \sin t), y(t) = 3(1 - \cos t)$

5. Write an integral for the area of the region inside the polar curve $r = \cos(3\theta)$.

6. Identify the graph of $4y^2 - 9x^2 + 36x = 72$ as a parabola, hyperbola, or ellipse, give coordinates of its vertices, and sketch a decent graph including any asymptotes.

7. Star is a Calculus student at Enormous State University, and they're having some trouble. Star says "Geez, this parametric stuff is just totally confusing! Sometimes you set the x part equal to 0 to find limits, but sometimes you set y equal to 0 instead. How am I supposed to know which?"

   Help Star out by explaining when each approach might be appropriate.

8. Set up an integral or integrals for the area of the region between the loops of the curve with polar equation $r = 3 - 5\cos\theta$.

9. Consider the curve with parametric equations $x(t) = \cos t,\ y(t) = \sin 3t$. Find the slopes of the curve at each point where it crosses the x-axis

10. Consider the curve with parametric equations $x(t) = \cos t,\ y(t) = \sin 3t$. Set up one or more integrals to give the area inside the curve.

Extra Credit [5 points possible]:
What can you say about the area inside one loop of the parametric curve

$$x(t) = \cos t + 2\cos\frac{t}{4}, \quad y(t) = \sin t - 2\sin\frac{t}{4}$$