Name : _____

(Perform reality check for each step with Desmos and verify your final answers with the provided answer key).

1. Consider the parametric curve $\Gamma : \begin{cases} x = 2t^2 - 5 \\ y = t^3 + t \end{cases}$, $-\infty < t < \infty$. Where does Γ have a

   tangent line that is perpendicular to the line $x + y + 3 = 0$?

2. Consider the parametric curve $\Gamma : \begin{cases} x = \cos(t) \\ y = \cos(3t) \end{cases}$, $0 \le t \le \pi$. Find the points on Γ where

   the tangent line is horizontal or vertical.

3. Consider the parametric curve $\Gamma : \begin{cases} x = \ln(\sin t) \\ y = t \end{cases}$, $\dfrac{\pi}{6} \le t \le \dfrac{\pi}{2}$. Find the arc length of Γ.

4. Consider the parametric curve $\Gamma : \begin{cases} x = 1 + e^t \\ y = t - t^2 \end{cases}$, $-\infty < t < \infty$. Find the area enclosed by the

   curve and the x-axis.

5. Consider the parametric curve $\Gamma : \begin{cases} x = 3t - t^3 \\ y = 3t^2 \end{cases}$, $0 \le t \le 1$. Find the area of the surface

   obtained by rotating Γ about the x-axis.

6. Consider the parametric curve $\Gamma : \begin{cases} x = e^t - t \\ y = 4e^{\frac{t}{2}} \end{cases}$, $0 \le t \le 1$. Find the area of the surface

   obtained by rotating Γ about the y-axis. (Optional)

7. Consider the parametric curve $\Gamma : \begin{cases} x = 2\cos^3 \theta \\ y = 2\sin^3 \theta \end{cases}$, $0 \le \theta \le \dfrac{\pi}{2}$.

   a. Find the points on Γ where the tangent line is horizontal or vertical.
   b. Find the arc length of Γ.
   c. Find the area of the surface obtained by rotating Γ about the x-axis.