Write clearly, explain, and simplify your answers

1. [5pts] Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for the parametric curve: $x = t - e^t$, $y = t + e^{-t}$.

2. [4pts] Set up an integral to find the arc length of the rose $r = 2 \cos 2\theta$. (Do not evaluate the integral.)
3. [5pts] Find the slope of the tangent line to the polar curve \( r = \frac{3}{1 + \cos \theta} \) at \( \theta = \pi/2 \).

4. [6pts] Find the area of the region inside the curve \( r = 3 \cos \theta \) and outside the curve \( r = 1 + \cos \theta \).
5. [5pts] Find the points of intersection (if any) of the sphere \( x^2 + y^2 + z^2 = 6 \) with the line that passes through the points \((3,0,3)\) and \((4,1,5)\).

6. [5pts] Determine whether the lines \( L_1 : x = t, y = 1+2t, z = 2+3t \) and \( L_2 : x = 3-4t, y = 2-3t, z = 1+2t \) are parallel, skew, or intersecting.
7. [6pts] Let $\vec{a} = \langle 3, 2, 1 \rangle$, $\vec{b} = \langle 1, 1, 2 \rangle$, $\vec{c} = \langle 1, 3, 3 \rangle$.

(a) Find $(\vec{a} \times \vec{b}) \cdot (2\vec{a} - \vec{b})$

(b) Find the volume of the parallelepiped with adjacent sides $\vec{a}$, $\vec{b}$, $\vec{c}$.

(c) Find the area of the parallelogram with adjacent sides $\vec{a} + 10\vec{b}$ and $\vec{b}$.