

1. Let $\vec{\alpha}(t) = \langle \cosh(t), \sinh(t), t \rangle$ for all parts of this problem. You do not need to repeat work.

(a) (5 points) Find the arc length of the trace of $\vec{\alpha}(t)$ from $t = 0$ to $t = 1$.

Hint: $\cosh^2(x) - \sinh^2(x) = 1$

(b) (4 points) Find the equation of the osculating plane for the trace of $\vec{\alpha}(t)$ at $t = 0$.

(c) (4 points) Find the curvature for the trace of $\vec{\alpha}(t)$ at $t = 0$.

2. (6 points) Find and simplify $I = \int_{-\pi/2}^{\pi/2} \langle \cos^2(t), t^2 \sin(t), \sin(2t) \sin(3t) \rangle dt$. Show work to defend your answer.

3. (6 points) Find $\vec{f}'(0)$ if $\vec{f}(t) = \vec{p}(t) \times \langle \sin(3t), \cos(3t), t^2 \rangle$, $\vec{p}(0) = \langle 1, 1, 1 \rangle$, and $\left. \frac{d\vec{p}}{dt} \right|_{t=0} = \langle 2, 3, 4 \rangle$. Show work to defend your answer.