

Problem 1. (10 pts) $\vec{r}(t) = \langle e^t \sin 2t, e^t \cos 2t, 2e^t \rangle$. Find the unit tangent vector at $t = 0$.

- A. $\langle 1/3, -1/3, 2/3 \rangle$
- B. $\langle 2/3, -1/3, 2/3 \rangle$
- C. $\langle 2/3, 1/3, 2/3 \rangle$
- D. $\langle 3/\sqrt{14}, -1/\sqrt{14}, 2/\sqrt{14} \rangle$
- E. None of the above

$$\dot{\vec{r}}(t) = \langle e^t(\sin 2t + 2\cos 2t), e^t(\cos 2t - 2\sin 2t), 2e^t \rangle$$

$$\dot{\vec{r}}(0) = \langle 2, 1, 2 \rangle \quad |\dot{\vec{r}}(0)| = 3$$

Problem 2. (10 pts) $\vec{r}(t) = \langle \cos^3 t, \sin^3 t, \cos^2 t \rangle$. Find the length traced out when $0 \leq t \leq \pi/2$.

- A. $2\sqrt{13}$
- B. $\sqrt{13}/2$
- C. $\sqrt{13}$
- D. $\pi/2$
- E. None of the above

$$\dot{\vec{r}}(t) = \langle -3\cos^2 t \sin t, 3\sin^2 t \cos t, -2\cos t \sin t \rangle$$

$$\begin{aligned} |\dot{\vec{r}}(t)|^2 &= 9\cos^4 t \sin^2 t + 9\sin^4 t \cos^2 t + 4\cos^2 t \sin^2 t \\ &= \cos^2 t \sin^2 t (4 + 9\cos^2 t + 9\sin^2 t) \\ &= 13\cos^2 t \sin^2 t \end{aligned}$$

$$\int_0^{\pi/2} |\dot{\vec{r}}(t)| dt = \int_0^{\pi/2} \sqrt{13} \cos t \sin t dt = \sqrt{13} \frac{\sin^2 t}{2} \Big|_0^{\pi/2} = \frac{\sqrt{13}}{2}$$