1. Find the limit if it exists: \[ \lim_{t \to \pi/2} <\cos t, t^2 + 3, \tan t> \]

2. If \( \mathbf{r}(t) = \sqrt{t^2 + 1}, \cos t, e^{-3t} > \), find \( \mathbf{r}'(t) \).

3. Evaluate the definite integral: \[ \int_{0}^{4} \left< 2te^{4t}, t^2 - 1, \frac{4t}{t^2 + 1} \right> \, dt \]
4. Find all values of $t$ for which $\mathbf{r}(t) \& \mathbf{r}'(t)$ are perpendicular: $\mathbf{r}(t) = < 2\cos t, \sin t >$

5. Find all values of $t$ for which $\mathbf{r}'(t)$ is parallel to the $xy$-plane:

$$\mathbf{r}(t) = < \sqrt{t+1}, \cos t, t^4 - 8t^2 >$$

6. Prove that if $\mathbf{r}(t) \& \mathbf{r}'(t)$ are orthogonal for all $t$, then $\|\mathbf{r}(t)\| = \text{constant.}$