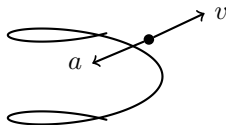


Question 4

For the helix $\vec{r}(t) = \langle 3 \cos t, 3 \sin t, 4t \rangle$, find velocity and acceleration. Prove that its speed is constant and decide whether acceleration is entirely normal.

Question 4 – Solution

Strategy Compute $\vec{v} \cdot \vec{a}$ after differentiating.



Derivatives

$$\vec{v} = \langle -3 \sin t, 3 \cos t, 4 \rangle, \quad \vec{a} = \langle -3 \cos t, -3 \sin t, 0 \rangle.$$

The speed is $\|\vec{v}\| = 5$, independent of t .

Decomposition Since

$$\vec{v} \cdot \vec{a} = 9 \sin t \cos t - 9 \sin t \cos t = 0,$$

acceleration is perpendicular to velocity. Hence $a_T = 0$ and all acceleration is normal, with $a_N = \|\vec{a}\| = 3$.