

Question 5

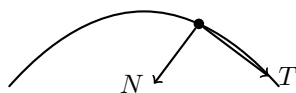
Let $\vec{r}(t) = \langle t, t^2, 0 \rangle$. Find $\mathbf{T}, \mathbf{N}, \mathbf{B}$ for all t . Explain why the binormal is constant and identify the direction in which the curve bends.

Calculus II Section 6-8: Tangent, Normal and Binormal Vectors

Question 5 – Solution

Strategy Normalize $\vec{r}'$, differentiate $\mathbf{T}$, and use the planar geometry as a check.

B perpendicular to curve's plane



Tangent and normal With $w = \sqrt{1 + 4t^2}$,

$$\mathbf{T} = \frac{1}{w} \langle 1, 2t, 0 \rangle, \quad \mathbf{N} = \frac{1}{w} \langle -2t, 1, 0 \rangle.$$

Consequently $\boxed{\mathbf{B} = \langle 0, 0, 1 \rangle}$.

Interpretation The curve is contained in the xy -plane, whose oriented unit normal is constant. The normal has positive y -component for all t , so the upward-opening parabola bends toward its concave side.