

$$\begin{aligned}
\text{(a) } \mathbf{r}(t) &= \langle 8t^2, \sin t - t \cos t, \cos t + t \sin t \rangle \Rightarrow \\
\mathbf{r}'(t) &= \langle 16t, \cos t + t \sin t - \cos t, -\sin t + t \cos t + \sin t \rangle \\
&= \langle 16t, t \sin t, t \cos t \rangle \Rightarrow \\
|\mathbf{r}'(t)| &= \sqrt{256t^2 + t^2 \sin^2 t + t^2 \cos^2 t} = \sqrt{256t^2 + t^2(\cos^2 t + \sin^2 t)} \\
&= \sqrt{257t^2} = \sqrt{257}t \text{ [since } t > 0]. \text{ Then} \\
\mathbf{T}(t) &= \frac{\mathbf{r}'(t)}{|\mathbf{r}'(t)|} = \frac{1}{\sqrt{257}t} \langle 16t, t \sin t, t \cos t \rangle = \frac{1}{\sqrt{257}} \langle 16, \sin t, \cos t \rangle. \\
\mathbf{T}'(t) &= \frac{1}{\sqrt{257}} \langle 0, \cos t, -\sin t \rangle \Rightarrow \\
|\mathbf{T}'(t)| &= \frac{1}{\sqrt{257}} \sqrt{0 + \cos^2 t + \sin^2 t} = \frac{1}{\sqrt{257}}. \\
\text{Thus } \mathbf{N}(t) &= \frac{\mathbf{T}'(t)}{|\mathbf{T}'(t)|} = \frac{1/\sqrt{257}}{1/\sqrt{257}} \langle 0, \cos t, -\sin t \rangle = \langle 0, \cos t, -\sin t \rangle.
\end{aligned}$$

$$\text{(b) } \kappa(t) = \frac{|\mathbf{T}'(t)|}{|\mathbf{r}'(t)|} = \frac{1/\sqrt{257}}{\sqrt{257}t} = \frac{1}{257t}$$