Consider the curve \( \vec{r}(t) = (e^t, \sqrt{2} t, e^{-t}) \). Compute each of the following.

Show your work. Simplify where possible.

1. velocity
   \[ \vec{v}(t) = \]

2. acceleration
   \[ \vec{a}(t) = \]

3. jerk
   \[ \vec{j}(t) = \]

4. speed (HINT: The quantity in the square root is a perfect square.)
   \[ |\vec{v}(t)| = \]

5. arclength between \((1,0,1)\) and \((e, \sqrt{2}, \frac{1}{e})\)
   \[ L = \]

6. unit tangent vector
   \[ \vec{T} = \]

7. \[ \vec{v} \times \vec{a} \]
   \[ \vec{v} \times \vec{a} = \]

8. \[ |\vec{v} \times \vec{a}| \]
   \[ |\vec{v} \times \vec{a}| = \]

9. unit binormal vector
   \[ \vec{B} = \]
10. unit normal vector
\[ \vec{N} = \]

11. curvature
\[ \kappa = \]

12. torsion
\[ \tau = \]

13. tangential acceleration (compute in 2 ways)
\[ a_T = \]

\[ a_T = \]

14. normal acceleration (compute in 2 ways)
\[ a_N = \]

\[ a_N = \]

15. mass of a wire between \((1,0,1)\) and \((e, \sqrt{2}, \frac{1}{e})\) with linear density \(\rho = x - z\)
\[ M = \]

16. work to move a bead along the wire from \((1,0,1)\) to \((e, \sqrt{2}, \frac{1}{e})\) with the force
\[ \vec{F} = (z,y,x) \]
\[ \vec{F}(\vec{r}(t)) = \]

\[ W = \]