If your last name begins with A-F, consider the curve $\vec{r}(t) = (t^2, 2t, \ln(t))$.
If your last name begins with G-L, consider the curve $\vec{r}(t) = (e^t \cos(t), e^t \sin(t), e^t)$.
If your last name begins with M-R, consider the curve $\vec{r}(t) = (3t^2, 4t^3, 3t^4)$.
If your last name begins with S-Z, consider the curve $\vec{r}(t) = (e^t, \sqrt{2}t, e^{-t})$.
Anyone may consider the curve $\vec{r}(t) = (\sinh(t), \cosh(t), t)$.

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 $t = 1$ and $t = 2$
   \[ L = \]

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

7. $\vec{v} \times \vec{a} =$

8. $|\vec{v} \times \vec{a}| =$

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 \( t = 1 \) and \( t = 2 \) with linear density \( \rho = x \)
\[ M = \]

16. work to move a bead along the wire from \( t = 1 \) to \( t = 2 \).
For all curves other than G-L, the force is \( \vec{F} = (0,y,x) \). For the G-L curve, the force is \( \vec{F} = (-y,x,0) \).
\[ \vec{F}(\vec{r}(t)) = \]
\[ W = \]