Instructions. Show all work, with clear logical steps. No work or hard-to-follow work will lose points.

Consider the curve

$$\mathbf{r}(t) = \langle e^t, e^{-t}, \sqrt{2}t \rangle, \quad 0 \le t \le \ln 2.$$

1.) (10 points) Find the velocity, speed and acceleration of $\mathbf{r}(t)$.

Solution. (a) Velocity: $\mathbf{r}(t) = \langle e^t, -e^{-t}, \sqrt{2} \rangle$

(b) Speed: $|\mathbf{r}'(t)| = \sqrt{e^{2t} + e^{-2t} + 2} = \sqrt{(e^t + e^{-t})^2} = e^t + e^{-t}$

(c) Acceleration: $\mathbf{r}''(t) = \langle e^t, e^{-t}, 0 \rangle$

□

2.) (10 points) Find the length of $\mathbf{r}(t)$.

Solution. The length of $\mathbf{r}(t)$ is given by

$$\begin{aligned} \int_0^{\ln 2} |\mathbf{r}'(t)| \, dt &= \int_0^{\ln 2} \left(e^t + e^{-t}\right) dt \\ &= e^t - e^{-t} \Big|_0^{\ln 2} \\ &= 2 - \frac{1}{2} - (1 - 1) \\ &= \frac{3}{2} \end{aligned}$$

□