Vector Functions and Curves
One variable functions

Question
Find the velocity, speed and acceleration of the particle with position given by $\underline{r}(t)$ at time t. Also determine the particles path.

$$\underline{r} = e^{-t}\cos(e^t)\underline{i} + e^{-t}\sin(e^t)\underline{j} - e^t\underline{k}$$

Answer
Position: $\underline{r} = e^{-t}\cos(e^t)\underline{i} + e^{-t}\sin(e^t)\underline{j} - e^t\underline{k}$
Velocity: $\underline{v} = -(e^{-t}\cos(e^t) + \sin(e^t))\underline{i} - (e^{-t}\sin(e^t) - \cos(e^t))\underline{j} - e^t\underline{k}$
Speed: $v = \sqrt{1 + e^{-2t} + e^{2t}}$
Acceleration:

$$\begin{aligned}\underline{a} &= ((e^{-t} - e^t)\cos(e^t) + \sin(e^t))\underline{i} \\ &\quad +((e^{-t} - e^t)\sin(e^t) - \cos(e^t))\underline{j} \\ &\quad -e^t\underline{k}\end{aligned}$$

Path: a spiral on the surface $z\sqrt{x^2 + y^2} = -1$.