

$$\text{a) } \mathbf{r}(t) = (t) \hat{\mathbf{i}} + (\sqrt{6}t^2/2) \hat{\mathbf{j}} + (t^3) \hat{\mathbf{k}}, \quad t \in [0,2]$$

$$\begin{aligned} L &= \int_0^2 ||\dot{\mathbf{r}}(t)|| \, dt = \int_0^2 \sqrt{1^2 + (\sqrt{6}t)^2 + (3t)^2} \, dt = \int_0^2 \sqrt{1 + 6t^2 + 9t^4} \, dt \\ &= \int_0^2 1 + 3t^2 \, dt = \left[t + t^3 \right]_0^2 = 10 \end{aligned}$$