1. Let C be the curve given by trajectory $\vec{r}(t) = \langle 2 - e^t, 4 - e^{-t} \rangle$ over the interval $[0, \ln 10]$. Find an interval $[a, b]$ over which $\vec{R}(t) = \left\langle 2 - t, 4 - \dfrac{1}{t} \right\rangle$ also follows C. At a point $\vec{r}(t) = \vec{R}(w)$, find the velocities of $\vec{r}$ and $\vec{R}$.

2. Show that the curve given by $\vec{r}(t) = \langle 3 \sin t, 5 \cos t, 4 \sin t \rangle$ lies on some sphere; find the radius of said sphere.

3. Let $\vec{r}(t) = \langle 5\cos t^2, 5\sin t^2 + 12t^2 \rangle$. Find the velocity of $\vec{r}(t)$ and the length of the trajectory for $0 \leq t \leq 2$.

4. Consider the parameterized curves $\vec{r}(t) = \langle f(t), g(t), h(t) \rangle$ and $\vec{R}(t) = \langle f(u(t)), g(u(t)), h(u(t)) \rangle$ where f, g, h, u are differentiable and u has an inverse on $[a, b]$. Show that the curve generate by $\vec{r}$ on $[a, b]$ is the same as the curve generated on $[u^{-1}(a), u^{-1}(b)]$ (or $[u^{-1}(b), u^{-1}(a)]$ as appropriate). Then show that the curve lengths as given by $\vec{r}$ and $\vec{R}$ are the same.