The graded part of the homework is on WebAssign. The problems below are also assigned and you are responsible for doing them, but they will not be collected or graded.

801. Let $\mathbf{r}(t)$ be a differentiable path in $\mathbb{R}^3$. Use the differentiation rules on page 218 to evaluate the following in terms of $\mathbf{r}(t)$ and its derivatives.

(a) Evaluate $\frac{d}{dt}(t^2 \mathbf{i} \times \mathbf{r}(t))$, $\frac{d}{dt}(t^2 \mathbf{r}(t))$, $\frac{d}{dt}(5t^2 \mathbf{i} + 3\mathbf{r}(t))$, and $\frac{d}{dt}\mathbf{r}(t^2)$.

(b) Evaluate $\frac{d}{dt}\|\mathbf{r}(t)\|$. **Hint:** Express $\|\mathbf{r}(t)\|$ in terms of $\mathbf{r}(t) \cdot \mathbf{r}(t)$.

(c) Evaluate and simplify $\frac{d}{dt}(\mathbf{r}(t) \times \mathbf{r}'(t))$.

(d) Prove that if the speed is constant, $\|\mathbf{r}'(t)\| = k = \text{constant}$, then the velocity and acceleration vectors are orthogonal.

**Hint:** What is the value of $\mathbf{r}'(t) \cdot \mathbf{r}''(t)$ and how is it related to the speed? Differentiate $\mathbf{r}'(t) \cdot \mathbf{r}'(t)$.

802. A particle travels on the path $\mathbf{c}(t) = e^t \mathbf{i} + e^{-t} \mathbf{j} - \sqrt{2} t \mathbf{k}$. Find the arc length between $e^{-3} \mathbf{i} + e^3 \mathbf{j} + 3\sqrt{2} \mathbf{k}$ and $e^2 \mathbf{i} + e^{-2} \mathbf{j} - 2\sqrt{2} \mathbf{k}$.

**Hint:** In computing the speed, you will get the square root of a perfect square of a function. Simplify to get a function that’s easy to integrate.