Supplementary Exercises for Section 12.2

1. What is the physical interpretation of the dot product of two vector valued functions? What is the physical interpretation of the cross product of two vector valued functions?

2. Show, using the rules of cross products and differentiation, that

$$\frac{d}{dt}[\mathbf{r}(t) \times \mathbf{r}'(t)] = \mathbf{r}(t) \times \mathbf{r}''(t)$$

3. Determine the point at which $\mathbf{f}(t) = \langle t, t^2, t^3 \rangle$ and $\mathbf{g}(t) = \langle \cos(t), \cos(2t), t + 1 \rangle$, and find the angle of intersection at that point. (Hint: You'll need to set this one up like a line intersection problem, writing one in $s$ and one in $t$.)

4. If the two functions in Exercise 3 were the trajectories of two airplanes on the same scale of time, would the planes collide at their point of intersection? Explain.