Homework for Section 13.5, MA113(Rickert)

Exercise 13.5 #9
Exercise 13.5 #12
Exercise 13.5 #20
For 4-8 Find $\mathbf{T}(t)$, $\mathbf{N}(t)$, $a_T$ and $a_N$ at the given times $t$ for the curve $\mathbf{r}(t)$.

4 $\mathbf{r}(t) = e^{-t} \cos(t) \mathbf{i} + e^{-t} \sin(t) \mathbf{j}$, $t = \pi/2$.
5 $\mathbf{r}(t) = a \cos(\omega t) \mathbf{i} + b \sin(\omega t) \mathbf{j}$, $t = 0$.
6 $\mathbf{r}(t) = (\omega t - \sin(\omega t)) \mathbf{i} + (1 - \cos(\omega t)) \mathbf{j}$, $t = t_0$.
7 $\mathbf{r}(t) = (\cos(3t), \sin(3t), 4t)$, $t = \pi/3$.
8 $\mathbf{r}(t) = (\cos(3t), \sin^3(t), \sin(3t))$, $t = \pi/9$.
9 For the baseball of exercise 13.2 #30,
   (A) Find $\mathbf{T}(t)$, $\mathbf{N}(t)$, $a_T$ and $a_N$.
   (B) What are $a_T$ and $a_N$ when the ball is passing over the 340 foot fence? What do these tell us?

10 A bumblebee is flying so that its position is given by

$$\mathbf{r}(t) = (\cos(2t), \cos(5t), \sin(3t)).$$

   (A) Find $\mathbf{r}(\pi/6)$, $\mathbf{v}(\pi/6)$, $\mathbf{a}(\pi/6)$.
   (B) Find $\mathbf{T}(\pi/6)$, $\mathbf{N}(\pi/6)$, $a_T(\pi/6)$ and $a_N(\pi/6)$.
   (C) For the osculating circle at $t = \pi/6$, find either the equation, or a set of parametric equations describing this osculating circle.