Problem Set 9

1. Find the length of the curve $\mathbf{r}(t) = < t, 3\cos(t), 3\sin(t) >$ for the interval $-5 \leq t \leq 5$.

2. Reparametrize the curve $\mathbf{r}(t) = 2t\mathbf{i} + (1 - 3t)\mathbf{j} + (5 + 4t)\mathbf{k}$ with respect to arc length measured from the point where $t = 0$ in the direction of increasing t.

3. For the vector equation $\mathbf{r}(t) = < t, 3\cos(t), 3\sin(t) >$, find $\mathbf{T}(t)$, $\mathbf{N}(t)$ and $\boldsymbol{\kappa}(t)$.

4. Find the curvature for $\mathbf{r}(t) = t^3\mathbf{j} + t^2\mathbf{k}$

5. Find the vectors **T**, **N**, and **B** for $\mathbf{r}(t) = < t^2, \frac{2}{3}t^3, t >$ at the point $(1, \frac{2}{3}, 1)$.

6. Find equations of the normal plane and osculating plane for the curve
$[x = 2\sin(3t), y = t, z = 2\cos(3t)]$ at the point $(0, \pi, -2)$

7. Find the velocity, acceleration, and speed of a particle with the position function
$\mathbf{r}(t) = 3\cos(t)\mathbf{i} + 2\sin(t)\mathbf{j}$ at $t = \frac{\pi}{3}$. Sketch the path of the particle and draw the velocity and acceleration vectors at t.

8. Find the velocity, acceleration, and speed of a particle with the position function
$\mathbf{r}(t) = < t^2 + t, t^2 - t, t^3 >$.

9. Find the velocity and position vectors of a particle with the following acceleration, initial velocity, and initial position:
$\mathbf{a}(t) = \mathbf{i} + 2\mathbf{j}$
$\mathbf{v}(0) = \mathbf{k}$
$\mathbf{r}(0) = \mathbf{i}$

10. Find the tangential and normal components of the acceleration vector,
$\mathbf{r}(t) = (3t - t^3)\mathbf{i} + 3t^2\mathbf{j}$.