**Math 2110Q Practice Midterm-I-1 Name:** _____

1. (10 pts) Consider the vectors $\mathbf{u} = (-1, 2, 3)$ and $\mathbf{v} = (2, 1, 1)$. Express $\mathbf{u}$ as the sum $\mathbf{u} = \mathbf{p} + \mathbf{n}$, where $\mathbf{p}$ is parallel to $\mathbf{v}$ and $\mathbf{n}$ is orthogonal to $\mathbf{v}$.

2. (10 pts) A particle with unit charge ($q = 1$) enters a constant magnetic field $\mathbf{B} = \mathbf{i} + \mathbf{j}$ with a velocity $\mathbf{v} = 20\mathbf{k}$. Find the magnitude and direction of the force on the particle.

3. (10 pts) Consider the plane $Q : x + y = 0$ and the curve $\mathbf{r}(t) = (\cos t, \sin t, t)$ for $0 \leq t \leq 4\pi$. Find the points at which the plane and curve intersect.

4. (10 pts) Evaluate the integral $\displaystyle\int_0^4 (\sqrt{t}\mathbf{i} + t^{-3}\mathbf{j} - 2t^2\mathbf{k})dt$.

5. (10 pts) Assume that the acceleration vector is given by $\mathbf{a}(t) = (1, t, 4t)$. Suppose that the initial velocity is $\mathbf{v}(0) = (20, 0, 0)$ and the initial position is $\mathbf{r}(0) = (0, 0, 0)$. Find the velocity $\mathbf{v}(t)$ and position $\mathbf{r}(t)$ for all $t$.

6. (10 pts) Consider the curve $\mathbf{r}(t) = (t - \sin t, 1 - \cos t)$. Find the length of the curve for $0 \leq t \leq 2\pi$.

7. (10 pts) Find the curvature of the curve $\mathbf{r}(t) = (7\cos t, \sqrt{3}\sin t, 2\cos t)$.

8. (10 pts) Skethc a graph of the surface $x^2 + \dfrac{y^2}{4} + \dfrac{z^2}{9} = 1$, and specify the intercepts with the three coordinate axes on the graph.

9. (10 pts) Consider the function $z = \sqrt{25 - x^2 - y^2}$. Graph the level curves corresponding to $z = 0$ and $z = 3$ on the $xy$-plane.

10. (10 pts) Evaluate the limit $\displaystyle\lim_{(x,y)\to(4,5)} \frac{\sqrt{x+y} - 3}{x + y - 9}$.