Your Name

Your Signature

Student ID #

Your TA's name

Your Quiz Section Label and Time

Problem	Possible	Points
1	8	
2	10	
3	10	
4	12	
5	10	
Total	50	

- No books allowed. You may use a scientific calculator and one $8\frac{1}{2} \times 11$ sheet of **handwritten** notes.

- Do not share notes.

- In order to receive credit, you must show your work and explain your reasoning (except on the "short answer" questions).

- **Place a box around** $\boxed{\textbf{YOUR FINAL ANSWER}}$ **to each question.**

- If you need more room, use the backs of the pages and indicate to the grader where to find your work.

- Raise your hand if you have a question or need more paper.

Don't open the test until everyone has a copy and the start of the test is announced.

1 (8 points total) Recall that $\vec{\imath}, \vec{\jmath}$, and $\vec{k}$ are the standard basis vectors. Give a **concrete** example of each of the following:

(a) (3 points) A **nonzero** vector $\vec{v}$ such that $\text{proj}_{\vec{k}}\,\vec{v} = \vec{0}$.

(b) (5 points) A **unit** vector that is perpendicular to both $\vec{\imath} + \vec{\jmath}$ and $\vec{\jmath} - \vec{k}$. How many different solutions are there?

2 (10 points) Consider the curve with the vector equation

$$\vec{r}(t) = \langle t, t^2 + 1, t^3 - 2t^2 \rangle$$

Is there a point on this curve where the tangent line is parallel to the vector $\langle 10, 40, 40 \rangle$? If so, find the point. If not, explain why.

3 (10 points total) Consider two planes given by the equations $x+2y-3z = 5$ and $2x-y+z = 0$.

(a) (5 points) Find parametric equations of the line where the planes intersect.

(b) (5 points) Find the cosine of the angle between the planes.

4 (12 points total) Consider the curve given by the equation in polar coordinates

$$r = 2\cos(\theta) + 4\sin(\theta).$$

(a) (6 points) Find the Cartesian equation (non-parametric, in x and y coordinates) of the curve. Sketch the curve.

(b) (6 points) Find the equation of the tangent line to the curve at $\theta = \pi/4$.

5 (10 points total) Consider the surface defined as the set of points which are equidistant from the x-axis and from the yz-plane.

(a) (6 points) Write down the equation of the surface.

(b) (4 points) Identify the surface.