Your Name

Your Signature

Student ID #

Your TA's name

Your Quiz Section Label and Time

Problem	Points	Possible
1		11
2		6
3		10
4		17
5		6
Total		50

- No books allowed. You may use a scientific calculator and one $8\frac{1}{2} \times 11$ sheet of 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 $\boxed{\text{YOUR FINAL ANSWER}}$ 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.

GOOD LUCK!

1. (**11=2+3+3+3 points**) Give an example of each of the following. (*No explanation of answers needed for this problem. Be sure to explain your answers on other problems!*)

   (a) A **nonzero** vector $\mathbf{v}$ such that $\text{proj}_{\mathbf{j}}\mathbf{v} = \mathbf{0}$

   (b) A vector of length 20 that is parallel to $2\mathbf{i} - \mathbf{j} - 2\mathbf{k}$. How many such vectors are there?

   (c) A vector that is perpendicular to both $\mathbf{i} - \mathbf{k}$ and $\mathbf{j} + \mathbf{k}$. How many such vectors are there?

   (d) Two nonzero vectors $\mathbf{u}$ and $\mathbf{v}$ such that $|\mathbf{u} \cdot \mathbf{v}| = |\mathbf{u}||\mathbf{v}|$.

2. (**6 points**) Find parametric equations for the line that contains the point $(-2, 3, 5)$ and is parallel to the planes $x + 2y + z = 4$ and $2x + 3z = 9$.

3. (**10=3+2+2+3 points**) Consider the surface $x = y^2 + z^2 - 4y - 2z + 5$.

   (a) Reduce this equation to one of the standard forms.

   (b) Identify the trace of the surface in the plane $x = 1$ (i.e., Is it an ellipse, a circle, a parabola, a hyperbola, etc?) and make a sketch of it.

   (c) Identify the trace of the surface in the plane $y = 3$. (i.e., Is it an ellipse, a circle, a parabola, a hyperbola, etc?) and make a sketch of it.

   (d) Identify the surface (i.e., Is this an ellipsoid, paraboloid, cone, hyperboloid of one sheet, etc?) and make a sketch of it. Your picture does not have to be drawn to scale. I am only interested in seeing the shape and orientation.

4. (**17=4+4+5+4 points**) Consider the curve given by the vector function $\mathbf{r}(t) = \langle \cos t, \cos t, \sqrt{2}\sin t \rangle$, where $0 \leq t \leq 2\pi$.

   (a) Compute $\mathbf{r}'(t)$ and $\mathbf{r}''(t)$.

   (b) Find a parametrization of the tangent line of this curve at the point $(1/2,\, 1/2,\, \sqrt{3/2})$.

   (c) Find the curvature of this curve at the point $(1/2,\, 1/2,\, \sqrt{3/2})$.

   (d) Reparametrize this curve with respect to arc length measured from the point where t = 0 in the direction of increasing t.

5. (**6 points**) Find all points of intersection between the curve defined by the polar equation $r = \sec\theta + 2\tan\theta$ and the vertical line $x = 3$ or explain why there are no intersection points.