Name: _____ ID Number: _____

TA: _____ Section Time: _____

1. (20 points) Find the center and the radius of the sphere $x^2 + y^2 + z^2 + 3x - 4y = 0$. Sketch a qualitative picture of the sphere in a Cartesian coordinate system in $\mathbb{R}^3$.

2. (10 points) Find the components in a Cartesian coordinate system of a force vector with magnitude $|\boldsymbol{F}| = 3$ and having an angle $\theta = \pi/3$ with the positive horizontal axis.

3. (a) (5 points) Find a unit vector in the direction of $\boldsymbol{v} = \langle -1, 2, 1 \rangle$.

(b) (5 points) Find the scalar projection of $\boldsymbol{w} = \langle 1, 2, 1 \rangle$ onto $\boldsymbol{v}$.

(c) (5 points) Find the vector projection of $\boldsymbol{w}$ onto $\boldsymbol{v}$.

4. (a) (10 points) Find the intersection of the lines

$$x = t, \qquad\qquad x = 2s + 2,$$
$$y = -t + 2, \qquad\qquad y = s + 3,$$
$$z = t + 1, \qquad\qquad z = 5s + 6.$$

(b) (10 points) Find the equation of the plane determined by these lines.

5. (a) (10 points) Find the cosine of the angle between the planes $2x - 3y + z = 1$ and $-x - 3y + 2z = 5$.

(b) (10 points) Find the vector equation of the line of intersection of the two planes given in (a).

6. (15 points) Sketch a graph of the surface $x^2 - y^2 + \dfrac{z^2}{4} = 0$.