1. Let $P$ be the point $(0, 2, 1)$, and $Q$ be the point $(-1, 3, 5)$.

(a) Write a vector parametrization of the line segment $PQ$.

(b) Find the area and the perimeter of triangle whose vertices are $P$, $Q$, and the origin.
2. Let \( p_1 \) be the plane \( 2x + 4y - z = 5 \) and \( p_2 \) be the plane \( x - 3y - 2z = 2 \).

(a) Find a vector parametrization for the line of intersection of \( p_1 \) and \( p_2 \).

(b) Find the cosine of the angle of intersection of the planes \( p_1 \) and \( p_2 \).
3. Let $\ell$ be the line with parametric equations

\begin{align*}
x &= 2t \\
y &= -2t \\
z &= -t
\end{align*}

and let $\vec{v} = (2, -5, 6)$. Find vectors $\vec{a}$ and $\vec{b}$ so that $\vec{a}$ is parallel to $\ell$, $\vec{b}$ is perpendicular to $\ell$, and $\vec{a} + \vec{b} = \vec{v}$. 
4. Identify and sketch the quadric surface $x^2 + y^2 + 2y - z^2 - 4z = 0$. 

5. (a) Find the cylindrical and rectangular coordinates for the point whose spherical coordinates are \( \rho = 3, \theta = \frac{\pi}{4}, \varphi = \frac{\pi}{6} \).

(b) Sketch the region described by \( 0 \leq \theta \leq \frac{\pi}{2}, 0 \leq r \leq 1, r^2 \leq z \leq 1 \).
6. My motorcycle gets about 50 miles to the gallon. I use the trip odometer to keep track of how far I’ve ridden between refuelings. When the trip odometer reads about 100 miles, I stop for fuel, and the tank usually takes about 2 gallons.

Of course, the odometer doesn’t always read exactly 100 miles at each fuel stop (there might not be a gas station right at that place in the road), and the tank doesn’t always take exactly 2 gallons.

Let $f(m, g)$ denote the motorcycle’s fuel economy (in miles per gallon) as a function of $m$, the number of miles driven, and $g$ the number of gallons of fuel used. Find a linear function $L(m, g)$ that best approximates $f$ when $m$ is near 100 and $g$ is near 2.
7. Here is a contour plot of a function $f(x, y)$. Use the contour plot to construct a reasonable linear approximation to $f$ at the point $(-1, -1)$. 

![Contour Plot](image)