1. (a) **(3 points)** Find the center and radius of the sphere $S : x^2 + y^2 + z^2 + 4x - 8y - 2z + 5 = 0$.

   (b) **(2 points)** Find points A, B on the sphere S such that AB is a diagonal of the sphere.

   (c) **(2 points)** Find the distance from the origin to the sphere S.

2. (a) **(2 points)** Find the unit vector $\mathbf{u}$ with direction angles $\frac{1}{3}\pi, \frac{1}{4}\pi, \gamma$, where γ is an obtuse angle.

   (b) **(2 points)** Find the angle between the vectors the vectors $3\mathbf{i}+\mathbf{j}-2\mathbf{k}$ and $\mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$ tp the neares hundredth radians.

   (c) **(2 points)** Find the vector projection of $\mathbf{a} = 3\mathbf{i} + \mathbf{j} - 2\mathbf{k}$ onto the vector $\mathbf{b} = \mathbf{i} + 2\mathbf{j} - 3\mathbf{k}$.

   (d) **(2 points)** Show that if $\mathbf{a} \cdot \mathbf{b} = \mathbf{a} \cdot \mathbf{c}$, then $\mathbf{b}$ and $\mathbf{c}$ have the same vector projction onto $\mathbf{a}$.

3. (a) **(2 points)** Find the volume of the parallelepiped with edges along the vectors $2\mathbf{i} + \mathbf{j}$, $3\mathbf{i} - 2\mathbf{k}$, $3\mathbf{j} + 2\mathbf{k}$.

   (b) **(3 points)** Find the distance between the point $P(1, 0, -1)$ and line through the points $A(1, 2, 1)$, $B(2, 2, -2)$.

4. (a) **(3 points)** Determine whether $l_1 : x = 3 + t, y = 1 - t, z = 5 + 2t$ and $l_2 : x = 1, y = 4 - t, z = 9 - 2t$ intersect. If so, find their point of intersection.

   (b) **(2 points)** Find parametric equations of the line through $P(1, 4, -3)$ and perpindicular to the yz-plane.

5. (a) **(3 points)** Find the equation of the plane through the point $P(2, 0, 1)$ and contains the line $l : x = 1 - 2t,\ y = 1 + 4t,\ z = 2 + t$.

   (b) **(2 points)** Find the distance from the point $P(2, -1, 3)$ to the plane $2x + 4y - z + 1 = 0$.