1. (5 points) Compute the distance between the points \( P_1(1, 4, 5) \) and \( P_2(4, -2, 7) \).

2. (5 points) Compute the length of the vector \( \mathbf{v} = 9\mathbf{i} - 2\mathbf{j} + 6\mathbf{k} \).

3. (10 points) Compute the dot product of the two vectors:
\[
\mathbf{v} = 2\mathbf{i} + 10\mathbf{j} - 11\mathbf{k}; \quad \mathbf{u} = 2\mathbf{i} + 2\mathbf{j} + 1\mathbf{k}.
\]

4. (a) (5 points) Find the area of the triangle that has vertices \( P, Q, \) and \( R \) where \( P(1, -1, 2); \ Q(2, 0, -1); \ R(0, 2, 1) \).

(b) (5 points) Find a unit vector that points perpendicular to the plane that contains this triangle.

(c) (5 points) Find the equation of the plane that contains these points.

5. (10 points) Compute the cross product \( \mathbf{u} \times \mathbf{v} \) where
\[
\mathbf{u} = 2\mathbf{i} + \mathbf{j} + \mathbf{k}; \quad \mathbf{v} = -4\mathbf{i} + 3\mathbf{j} + 2\mathbf{k}.
\]

6. (10 points) Find a vector that is parallel to the line of intersection between the planes
\[
3x - 6y - 2z = 15; \quad 2x + y - 2z = 5.
\]

7. (10 points) Determine the intercepts of the plane
\[
3x + 2y + 5z = 30
\]
with each of the coordinate axes.
8. Consider the quadratic surface 
\[ z = 5x^2 + 5y^2. \]

(a) (5 points) Sketch the intersection of this surface with the \((y, z)\)-plane \(x = 0\).
(b) (5 points) Sketch the intersection of this surface with the \((x, z)\)-plane \(y = 0\).
(c) (5 points) Sketch the intersection of this surface with the horizontal plane \(z = 125\).
(d) (5 points) Draw or describe the surface.
(e) (5 points) For this same surface consider \(z = f(x, y)\). Compute \(\frac{\partial f}{\partial x}\) and \(\frac{\partial f}{\partial y}\).

9. Recall that the velocity \(\mathbf{v}(t) = \mathbf{r}'(t)\), the unit tangent vector is \(\mathbf{T} = \mathbf{v}(t)/||\mathbf{v}(t)||\) and the principal normal vector \(\mathbf{N} = \frac{d\mathbf{T}}{dt}/||d\mathbf{T}/dt||\). (15 points) Compute these quantities for the helix
\[ \mathbf{r}(t) = (3 \cos (t)) \mathbf{i} + (3 \sin (t)) \mathbf{j} + 4t \mathbf{k}. \]