Answer each of the following questions. Show all work, as partial credit may be given.

1. (6 pts. each) Let \( a = 6\mathbf{i} - 5\mathbf{j} + \mathbf{k} \), \( b = \mathbf{i} + \mathbf{k} \), and \( c = \mathbf{i} + \mathbf{j} - 3\mathbf{k} \). Find each of the following.

   (a) The angle between \( a \) and \( b \) correctly rounded to the nearest degree.

   (b) A unit vector perpendicular to both \( b \) and \( c \).

   (c) The vector projection of \( a \) along \( b \).

   (d) Parametric equations for the line through the point \((6, -5, 1)\) parallel to \( c \).

   (e) The equation of the plane containing the point \((1, 1, -3)\) with normal vector \( a \). Put your answer in the form \( Ax + By + Cz = D \).

   (f) The volume of the parallelepiped formed by the vectors \( a \), \( b \), and \( c \). (Hint: This is \(|a \cdot (b \times c)|.|\))

2. Let \( A = (2, 4, 5) \), \( B = (0, 0, 1) \) and \( C = (3, -1, 2) \).

   (a) (10 pts.) Find an equation for the plane containing the points \( A \), \( B \) and \( C \). Put your answer in the form \( Ax + By + Cz = D \).

   (b) (5 pts.) Find the area of the triangle with vertices \( A \), \( B \), and \( C \).

3. (10 pts.) Find parametric equations for the line of intersection of the planes given by \( x - y + z = 1 \) and \( 2x + y + z = 2 \).

4. (10 pts.) The position vector of a particle in space is given by the vector-valued function \( \mathbf{r}(t) = (t - \sin t)\mathbf{i} + (1 - \cos t)\mathbf{j} + t\mathbf{k} \).

   (a) Find the velocity, acceleration and speed of the particle.

   (b) Find parametric equations for line tangent to the path of the particle when \( t = 0 \).

5. (10 pts. each) Consider the curve given by the vector-valued function \( \mathbf{r}(t) = (2t + 3)\mathbf{i} + (5 - t^2)\mathbf{j} + 3t\mathbf{k} \), for \( 1 \leq t \leq 4 \).

   (a) Find the unit tangent vector for the above curve.

   (b) Set up but DO NOT EVALUATE an integral giving the length of the above curve.