MATH 213 – 17 JUNE 2004 – EXAM 1

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

1. (6 pts. each) Let \( P = (-1, 2, 2) \), \( Q = (1, 0, 1) \) and \( R = (3, 1, -4) \).
   
   (a) Find the vectors \( \overrightarrow{PQ} \) and \( \overrightarrow{PR} \).
   
   (b) Find parametric equations for the line containing the points \( Q \) and \( R \).
   
   (c) Find the area of the triangle formed by the points \( P, Q, \) and \( R \).
   
   (d) Find the equation of the plane containing the points \( P, Q, \) and \( R \). Write the equation in the form \( Ax + By + Cz = D \) for appropriate constants \( A, B, C, \) and \( D \).

2. (6 pts. each) Let \( u = \mathbf{i} + \mathbf{k} \), \( v = \mathbf{i} + 2\mathbf{j} \), and \( w = 6\mathbf{i} - \mathbf{j} - 3\mathbf{k} \).
   
   (a) Find the angle between \( u \) and \( v \) correct to the nearest tenth of a degree or hundredth of a radian. Please indicate whether your answer is in degrees or radians.
   
   (b) Write \( u \) as the sum of a vector parallel to \( v \) and a vector perpendicular to \( v \).
   
   (c) Find the triple scalar product \( (u \times v) \cdot w \).

3. (6 pts. each) Suppose that \( r(t) = (t + 1)\mathbf{i} + t \cos(t)\mathbf{j} + (t^3 + t)\mathbf{k} \) represents the position of a particle at time \( t \).
   
   (a) Find the particle’s velocity and acceleration vectors.
   
   (b) Find the speed and direction of motion of the particle at \( t = 0 \).