First Hour Exam

(20 pts) 1. Consider the three points \( P = (5, 2, -1), Q = (1, 4, 1), R = (1, 2, 3) \) in \( \mathbb{R}^3 \).
   
   (a) Find an equation for the plane which contains \( P, Q \) and \( R \).
   
   (b) Find the area of the triangle with vertices at \( P, Q \) and \( R \).
   
   (c) Find the angle between \( PQ \) and \( PR \).

(20 pts) 2. A particle moves along the space curve \( r(t) = (\cos 2t)i + (3t - 1)j + (\sin 2t)k \).
   
   (a) Find the velocity, speed, and acceleration of the particle (as functions of \( t \)).
   
   (b) Find the principal unit normal vector at \( t = 0 \).

(20 pts) 3. Let \( f(x, y, z) = \sqrt{xy} + 2xz + 3yz \).
   
   (a) Find \( \frac{\partial f}{\partial x}, \frac{\partial f}{\partial y}, \text{and} \frac{\partial f}{\partial z} \).
   
   (b) Let \( x = uv, y = u + 2v, \text{and} z = -v^2 \). Compute \( \frac{\partial f}{\partial u} \) when \( u = 2 \) and \( v = -1 \).

(20 pts) 4. Let \( f(x, y) = \frac{2(x + 1)}{4x^2 + 5(y + 1)^2} \).
   
   (a) Evaluate \( \lim_{(x,y)\to(0,-1)} f(x, y) \) or show that it doesn’t exist.
   
   (b) Evaluate \( \lim_{(x,y)\to(0,1)} f(x, y) \) or show that it doesn’t exist.

(20 pts) 5. Find the arc length of the curve \( c(t) = \langle 2t - 1, 2\ln t, 1 - \frac{1}{2}t^2 \rangle \) from \( t = 1 \) to \( t = e \).

Hand in this sheet along with your exam booklet!