0. (1 point) Carefully read and complete the instructions at the top of this exam sheet and any additional instructions written on the chalkboard during the exam.

1. Let \( P = (6, 4, -1), \ Q = (5, 7, 1) \) and \( R = (6, 9, 0) \) be three points in \( \mathbb{R}^3 \).
   
   (a) (4 points) Find a formula \( ax + by + cz = d \) for the plane containing the points \( P, \ Q \) and \( R \).
   
   (b) (2 points) The points \( P, \ Q \) and \( R \) form a triangle \( \triangle PQR \) in \( \mathbb{R}^3 \). Determine whether \( \angle Q \) (the angle at the vertex \( Q \)) is an acute, obtuse or right angle. Be sure to justify your answer.

2. (6 points) Find a vector parametrization \( \mathbf{r}(t) = \mathbf{r}_0 + \mathbf{v}t \) for the line of intersection of the two planes given by \( 6x - 3y + 2z = 2 \) and \( x + 2y - 2z = 1 \).

3. Tom is chasing Jerry up a spiral staircase. The position of Tom at time \( t \) is \( \mathbf{T}(t) = \langle \cos(3\pi t), \sin(3\pi t), 3t \rangle \) and the position of Jerry is \( \mathbf{J}(t) = \langle \cos(\pi t), \sin(\pi t), t + 4 \rangle \). The chase starts at time \( t = 0 \).
   
   (a) (3 points) At what time does Tom catch Jerry?
   
   (b) (3 points) What is the distance covered by Tom from time \( t = 0 \) until he catches Jerry?

4. (6 points) A particle follows a path \( \mathbf{r}(t) \) that satisfies \( \mathbf{r}'(t) \cdot \mathbf{r}''(t) = 0 \). The particle's velocity at time \( t = 0 \) is \( \mathbf{r}'(0) = \langle 2, 4, 4 \rangle \). Determine the total distance traveled by the particle along the path from \( t = 0 \) to \( t = 1 \).