Hand your completed quiz in before the due date. Do not forget to write down your name and student ID number. Marks will be awarded for this quiz based on the clarity of your answers. The marker will pay close attention to the logic of your answers. Please show all your working.

Q1. Let \( p_0 = (1, 2, 3) \) and \( p = (x, y, z) \). Describe the set of all points \((x, y, z)\) for which \( \|p - p_0\| = 1 \).

Q2. Find \( u \cdot v \).
   (a) \( u = (2, 3), \ v = (5, -7) \).
   (b) \( u = (1, 2, 3), \ v = (4, 5, 6) \).

Q3. Determine whether the angle between \( u \) and \( v \) is greater than, less than, or equal to 90°.
   (a) \( u = (6, 1, 4), \ v = (2, 0, -3) \).
   (b) \( u = (2, 4, -8), \ v = (5, 3, 7) \).

Q4. Find the orthogonal projection of \( u \) on \( a \).
   (a) \( u = (6, 2), \ v = (3, -9) \).
   (b) \( u = (3, 1, -7), \ v = (1, 0, 5) \).
   (c) \( u = (1, 0, 0), \ v = (4, 3, 8) \).

Q5. In each part of Q4, find the vector component of \( u \) orthogonal to \( a \).

Q6. 
   (a) Show that \( v = (a, b) \) and \( w = (-b, a) \) are orthogonal vectors.
   (b) Use the result in the last part to find two vectors that are orthogonal to \( v = (2, -3) \).
   (c) Find two unit vectors that are orthogonal to \( (-3, 4) \).

Q7. Show that \( A(3, 0, 2), \ B(4, 3, 0), \ C(8, 1, -1) \) are vertices of a right triangle. At which vertex is the right angle?

Q8. Find a unit vector that is orthogonal to both \( v = (1, 0, 1) \) and \( u = (0, 1, 1) \).

Q9. (Optional) Prove: \( \|u + v\|^2 + \|u - v\|^2 = 2\|u\|^2 + 2\|v\|^2 \).