To receive full credits, write down all steps. No aide besides a scientific calculator is allowed.

1. (7 points) Let \( \vec{a} = (1, 2, 3) \) and \( \vec{b} = (1, 4, -3) \).

   (1). Find \( 2\vec{a} - \vec{b} \).
   \[
   2\vec{a} - \vec{b} = \langle 2, 4, 6 \rangle - \langle 1, 4, -3 \rangle = \langle 1, 0, 9 \rangle
   \]

   (2). Find the length of \( \vec{a} \).
   \[
   |\vec{a}| = \sqrt{1^2 + 2^2 + 3^2} = \sqrt{14}
   \]

   (3). Find the dot product \( \vec{a} \cdot \vec{b} \).
   \[
   \vec{a} \cdot \vec{b} = \langle 1, 2, 3 \rangle \cdot \langle 1, 4, -3 \rangle = 1 + 8 - 9 = 0
   \]

   (4). What is the angle between \( \vec{a} \) and \( \vec{b} \)? (Hint: using the result in (3))
   Since \( \vec{a} \cdot \vec{b} = 0 \), then \( \vec{a} \) and \( \vec{b} \) are orthogonal.

   A. 0  B. \( \frac{\pi}{2} \)  C. \( \frac{\pi}{3} \)  D. \( \frac{\pi}{4} \)  E. \( \pi \)

2. (3 points)
   (1) Find the equation of a sphere with center \((1, -2, 3)\) and radius 3.
   \[
   (x-1)^2 + (y+2)^2 + (z-3)^2 = 9
   \]

   (2) How does this sphere in (1) intersect with the xy-plane? (Hint: using the equation of the sphere and the equation of the xy-plane)
   A. a circle  B. a single point  C. no intersection
   \[
   (x-1)^2 + (y+2)^2 + (z-3)^2 = 9
   \]
   \[
   (x-1)^2 + (y+2)^2 = 9
   \]
   \[
   (x-1)^2 + (y+2)^2 = 0
   \]
   \[
   x = 1, \quad y = -2
   \]