NAME: SEC#:   ID#:

SHOW ALL YOUR WORK

1. **(4pts each)**

    a. Let $\mathbf{u} = \langle \alpha, 1 + \alpha \rangle$, $\mathbf{v} = \langle 4, -2 \rangle$, $\mathbf{w} = \langle 3, 1 \rangle$. Find all possible values of α if $\|\mathbf{u}\|(\mathbf{v} \cdot \mathbf{w}) = 10$

    b. Let $\mathbf{v} = \langle 3, 1, -2 \rangle$, $\mathbf{b} = 2\mathbf{i} - \mathbf{k}$. Express $\mathbf{v}$ as the sum of a vector parallel to $\mathbf{b}$ and a vector orthogonal to $\mathbf{b}$.

    c. Give all angles of the triangle $A(-1, 2, 3)$, $B(2, -2, 0)$, $C(3, 1, 4)$

2. (5pts each)

    a. Find the equation of the sphere with center in the middle of the line segment $A(-1, 2, 3)$, $B(3, -2, -1)$ and which touches the x−axis

    b. Find the center and radius of the sphere $x^2 + y^2 + z^2 - 2x - 4y + 1 = 0$. Hence find the distance between the point $A(-1, 2, 3)$ and the sphere.

3. (6pts each)

    a. Find the equation of the tangent line to the polar curve $r = 2\cos\theta$ at $\theta = \frac{\pi}{3}$. Give your equation in polar form.

    b. Calculate the length of the entire cardioid $r = a(1 + \cos\theta)$.

4. (6pts) Set up an integral to calculate the area inside the cardioid $r = a(1 + \cos\theta)$ and outside the circle $r = 3a\cos\theta$. Do not carry out the integration.