Name: _______________________________________

Student ID: ________________________________

Section time: _______________________________

Instructions:

Please print your name, student ID and section time.

During the test, you may not use books, calculators, telephones. You may use a "cheat sheet" of notes which should be a page, front only.

Read each question carefully, and show all your work. Answers with no explanation will receive no credit, even if they are correct.

There are 4 questions which are worth 40 points. You have 50 minutes to complete the test.

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Problem 1. [11 points; 3, 4, 4.]

Consider the vectors \( \vec{v} = \vec{i} + 2\vec{j}, \quad \vec{w} = 3\vec{i} + \vec{j} \).

(i) Find the unit vector \( \vec{u} \) in the direction of \( \vec{v} \).

(ii) Find the component \( \vec{w}_\parallel \) of \( \vec{w} \) in the direction of \( \vec{u} \).

(iii) Find the angle between the vectors \( \vec{v} \) and \( \vec{w} \).
Problem 2. \([10 \text{ points; 5, 5.}]\)

Consider the function

\[ f(x, y) = 1 + \sqrt{x^2 + y^2}. \]

(i) Draw the contour diagram for \(f(x, y)\) and clearly label the level curves. Show the contours for at least three levels.

(ii) Draw the graph of \(z = f(x, y)\).
Problem 3. [10 points; 5, 5.]

Consider the points $P(3, 0, -1)$, $Q(1, 1, 0)$ and $R(-1, 1, 2)$.

(i) Find the equation of the plane through $P$, $Q$ and $R$.

(ii) Find the area of the triangle $PQR$. 
Problem 4. [9 points; 4, 5.]

Consider the plane $P$ with equation $z = 6x - 3y + 2$.

(i) Find the equation of a plane parallel to $P$ and passing through the point $(1, 0, -1)$.

(ii) For which value of $a$ is the vector $(-2, 1, a)$ normal to the plane?