Name: _________________________________

Student ID: _________________________________

Section time: _________________________________

Instructions:

Please print your name, student ID and section time.

During the test, you may not use books or 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 45 points. You have 50 minutes to complete the test.

<table>
<thead>
<tr>
<th>Question</th>
<th>Score</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>45</td>
</tr>
</tbody>
</table>
Problem 1. [10 points; 4, 3, 3.]

Consider the vectors
\[ \mathbf{v} = i + 2j, \quad \mathbf{w} = 3i - j. \]

(i) Draw the two vectors \( \mathbf{v} \) and \( \mathbf{w} \) in standard position, and draw their sum \( \mathbf{v} + \mathbf{w} \).

(ii) Compute the vector \( 2\mathbf{v} + 3\mathbf{w} \).

(iii) Find the unit vector \( \mathbf{u} \) in the direction of \( \mathbf{w} \).
Problem 2. [10 points; 5, 5.]

Consider the function

\[ f(x, y) = (x - 1)^2 + (y - 1)^2. \]

(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.]

(i) Suppose that $z = f(x, y)$ is a linear function of $x$ and $y$, with slope 3 in the $x$ direction and slope $-2$ in the $y$ direction. A change of .1 in $x$ and $-2$ in $y$ produces what change in $z$?

(ii) The graph of a linear function $z = g(x, y)$ passes through the point $(1, 2, 5)$. The graph intersects the $xz$ plane along the line $z = 3x + 6$. Determine the linear function $g$. 
Problem 4. [15 points; 5, 5, 5.]

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

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

(ii) Find the cosine of the angle between the vectors $\vec{PQ}$ and $\vec{PR}$. 
(iii) Find the area of the triangle $PQR$. 