<table>
<thead>
<tr>
<th>Problem</th>
<th>Points</th>
<th>Score</th>
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<tbody>
<tr>
<td>1</td>
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<td>4</td>
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<td>5</td>
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<tr>
<td>Total</td>
<td>81</td>
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Show all work.

1. Given \( \mathbf{u} = (-3, 4, 1) \) and \( \mathbf{v} = (-2, 5, -1) \), compute (30 points, 3 each)
   
   a) \( 5\mathbf{u} - 3\mathbf{v} \)
   
   b) \( \| \mathbf{u} \| \)
   
   c) \( \mathbf{u} \cdot \mathbf{v} \)
   
   d) \( \mathbf{u} \times \mathbf{v} \)
   
   e) a vector with length 7 \( \| \) to \( \mathbf{v} \)
   
   f) a line \( \perp \) to both \( \mathbf{u} \) and \( \mathbf{v} \)
   
   g) \( \| \text{Proj}_v \mathbf{u} \| \)
   
   h) a line through point \( (4, -3, 3) \) and \( \| \) to \( \mathbf{v} \)
   
   i) a plane through point \( (1, -1, 5) \) which contains \( \mathbf{u} \) and \( \mathbf{v} \)
   
   j) the volume of the parallelepiped with corner formed from \( \mathbf{u}, \mathbf{v}, \) and \( \mathbf{w} = (4, 0, 0) \)
2 a) Find the equation of the line through points \((7, -2, -3)\) and \((6, 4, -3)\).
(12 points, 4 each)

b) Find the equation of the line through the point \((1, 7, 2)\) and \(\perp\) to the plane \(x = 3y - z\).

c) Find where the line \(x = 2 + 2t, y = 2 - t, z = 3 + t\) intersects the plane \(2x + y + 3z = 3\)

3 a) Find the equation of a plane which is parallel to the plane \(2x - y - z = 1\) and a distance of 100 away from it.
(12 points, 6 each)

b) Find the equation of the plane through the 3 points \((2, 2, -1), (-3, 0, 1),\) and \((0, 1, 1)\).
4. Let $\mathbf{a}$ and $\mathbf{b}$ be non-zero vectors.

(15 points, 5 each)

a) If $\mathbf{a} \cdot \mathbf{b} = \sqrt{3}$, $\mathbf{a} \times \mathbf{b} = (1, 0, 0)$, and $\| \mathbf{a} \| = 1$, find the angle $\theta$ between $\mathbf{a}$ and $\mathbf{b}$.

b) Prove or disprove: $\mathbf{a} \times \mathbf{b}$ is $\perp$ to $\mathbf{a} - \mathbf{b}$

c) If $\| \text{Proj}_\mathbf{a} \mathbf{b} \| = \| \mathbf{b} \|$, what can you conclude and why?

5. a) Find the equation of 3 different lines that lie on the plane $x - 2y + 10z = 4$.

(12 points, 6 each)

b) Determine if the 4 points $(1, 2, 3)$, $(2, 3, 4)$, $(-1, 1, 2)$ and $(0, 1, 0)$ all lie on a plane or not.