1. Consider the points $P(3,1,1), Q(4,1,2)$, and $R(4,4,1)$ in $\mathbb{R}^3$.
   (a) [3 pts] Find an equation for the plane containing the points P, Q, and R.

   (b) [2 pts] Find the area of the triangle with vertices P, Q, and R.

2. [4 pts] Find an equation of the plane which passes through the points $(2,2,1)$ and $(-1,1,-1)$ and is perpendicular to the plane $2x - 3y + z = 3$.

3. [4 pts] Find a set of parametric equations for the line of intersection of the planes:

$$\begin{cases} 6x - 3y + z = 5 \\ -x + y + 5z = 5 \end{cases}$$

4. [4 pts] Given the line L through $(1, 2, 3)$ parallel to the vector $\langle 1, 1, 1\rangle$, and given a point $(2, 3, 5)$ which is not on L. Find a Cartesian equation for the plane M through $(2, 3, 5)$ which contains every point on L.

5. [3 pts] If the three vectors $\mathbf{u}$, $\mathbf{v}$, $\mathbf{w}$ in $\mathbb{R}^3$ satisfy $\mathbf{u}\times\mathbf{v} \neq \mathbf{0}$ and $\mathbf{u}\times\mathbf{w} \neq \mathbf{0}$, but $(\mathbf{u}\times\mathbf{v})\cdot(\mathbf{u}\times\mathbf{w}) = \mathbf{0}$, then it follows that

   (a) The plane spanned by $\mathbf{u}$ and $\mathbf{v}$ is orthogonal to the one spanned by $\mathbf{u}$ and $\mathbf{w}$.

   (b) $\mathbf{v} \perp \mathbf{w}$.

   (c) $\mathbf{u} \perp \mathbf{v}$ and $\mathbf{u} \perp \mathbf{w}$.

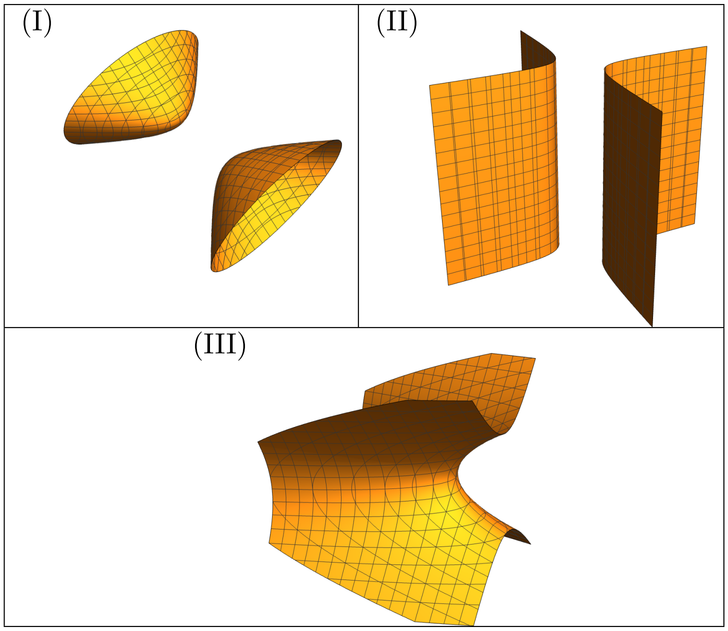
   (d) $\mathbf{u}$, $\mathbf{v}$ and $\mathbf{w}$ lie in the same plane.

6. [3 pts] Determine whether the parametrizations

$$\mathbf{r}_1(t) = \langle 3, -1, 4\rangle + t\langle 8, 12, -6\rangle \quad \text{and} \quad \mathbf{r}_2(t) = \langle 11, 11, -2\rangle + t\langle 4, 6, -3\rangle$$

describe the same line. If they do, show why. If they don't, show why not.

7. [4 pts] Match the contour surfaces with their equations. Enter O if there's no match.



$g(x,y,z) =$	O, (I), (II), (III)
$x^2 - y^2 + z^2 = 1$	
$x^2 - y^2 = 1$	
$x^4 + z = 1$	
$x^2 + y - z^2 = 1$	

 Points earned: ____
out of a possible 4 points