1. $a = < 1, 3, -3 >, b = < 2, 2, 4 >$.
   i. Find the component of **b** in the direction of **a**.
   ii. Determine the orthogonal projection of **b** onto **a**.
2. Express $b = < -4, 1 - 2 >$ as $b = b1 + b2$ where **b1** is parallel to **a** and b2 is orthogonal to **a** and $a = < 1, 3, -3 >$.
3. Find the equation of a plane that contains the points $(1, -1, 4), (0, 2, 3)$ *and* $(2, 1, 0)$
4. Find the equation of a plane that contains the point $(1, 0, -1)$ and is parallel to the plane $x + y - z = 4$.
5. Find the equation of a line that satisfies the condition that it passes through the point $(1, 2, 3)$ and is parallel to the line whose parametric equations $x = t + 1, y = -t, z = t - 4$.

V. Sketch the following:

1. The surface $x^2 - y^2 - z^2 - 4x - 4y = 0$ (hint: complete the square). Partial credit will be given for the sketch in each of the planes.

2. For $r(t) = (t, \sqrt{2}\cos(t), \sqrt{2}\sin(t))$.
   a. Sketch the curve.
   b. Find the arc length from $t = 0$ to $t = \pi$
   c. Treating $r(t)$ as a particle motion, find $v(t)$ and $a(t)$
1. Sketch the region bounded by the cone $z = \sqrt{(x^2 + y^2)}$ and the plane $z = 2$.

2. Sketch the region bounded by the cone whose angle in spherical coordiantes is given by $\phi = \frac{\pi}{4}$ and a sphere of radius2.

2. Sketch $x^2 + y^2 + z - 9 = 0$

IV. Find the equation of the Plane which satisfy the following:

1. A plane through the points $(0, 0, 0), (1, 1, 1), (1, 2, 3)$.

2. A plane through the point $(0, 1, 2)$ and containing the line $x = t, 2y = t, 3z = t$.

3. Find the point where the line $x = t + 1, y = 2t, z = 3t$ and the plane $x + y + z = 1$ intersect.

I. Answer the following:

1a.) What is the area of the triangle whose vertices are: $v_1 = (0,0,1)$, $v_2 = (0,2,0)$ and $v_3 = (3,0,0)$.

1b. Find a parallelogram where 3 vertices are: $v1 = (0,0,1), v2 = (0,2,0), andv3 = (3,0,0)$

2.) Assume V satisfies $A \times V = B$ where A is a unit vector and $B \perp A$ Using the fact that $Ax(BxC) = (A \cdot C)B - (A \cdot B)C$ Simplify the following:

i.) $V = B + (A \times B)$.

ii.) $V = B - (A \times B)$.

iii.) $V = (A \times B)$.

iv.) $V = A + (A \times B)$.

v.) $V = A - (A \times B)$.

3.) Let L be the line in R^3 that passes through the points $P = (-1,-2,4)$ and $Q = (4,2,1)$. At what point (if any) does L intersect the plane $x + y + 2z = 11$?

4.) Let $P = (1,-1,1)$ and $Q = (-3,3,3)$. Find the point R such that:

i.) R is half way between P and Q.

ii.) R three fourths of the distance between them.

5.) If L is the line through $A = (3,2,1)$ and parallel to the vector $v =< -2,1,3 >$, what's the equation of the plane that contains L and the point $B = (-2,3,1)$.

6.) Find the distance from the origin to the plane $x + 2y + 2z = 6$.

7a.) Find the equation of the surface traced by $z = f(x)$ in the x-z plane and revolved around the $x = axis$.

7b.) Let C be the circle in the $y - z$ plane whose equation is $(y-3)^2 + z^2 = 1$. If C is revolved around the z axis, the surface generated is a torus"doughnut". Find its equation.

8.) The plane $y = 1$ slices the surface $z = \arctan(\frac{x+y}{1-xy})$ in a curve C. Find the slope of the tangent line to C at the point where $x = 2$.

9.) Graph in cylindrical coordinates the surface $z = r^2\cos(2\theta)$.

10.)

i.) Graph the surface $z = 8xy$.

11.) Graph the solid in the first octant bounded by the plane $x+2y+z=4$.

12.) Graph the solid inside the paraboloid $z=(x^2+y^2)$ and below the plane $z=1$.