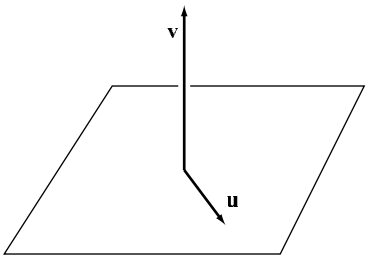
Fall '10/MAT 309/Exam 1 Name: *Show all your work.*

1. (22pts) Let $\mathbf{u} = \langle 1, 2. - 3\rangle$ and $\mathbf{v} = \langle 4, -1, -4\rangle$.
a) Calculate $3\mathbf{u}$, $2\mathbf{u} - 4\mathbf{v}$, $\mathbf{u} \cdot \mathbf{v}$ and $||v||$.
b) Find the unit vector in direction of $\mathbf{v}$.
c) Find the angle between $\mathbf{u}$ and $\mathbf{v}$.

2. (8pts) Vectors $\mathbf{u}$ and $\mathbf{v}$ are drawn below (they are perpendicular). Their lengths are $||\mathbf{u}|| = 3$ and $||\mathbf{v}|| = 1.5$. Draw the vector $\mathbf{u} \times \mathbf{v}$ and state its length.



3. (12pts) Find the point of intersection of the line $x = 2 + t$, $y = -3 + 2t$, $z = 5t$ with the plane $2x - 3y + z = 11$.

4. (20pts) Two lines are given parametrically: $x = 1 - t$, $y = 4 + 2t$, $z = 3 + 2t$ and $x = 2t$, $y = 1 - 4t$, $z = -3 - 4t$.
a) Show that these lines are parallel.
b) Find the equation of the plane spanned by these two lines.

5. (16pts) This problem is about the surface $-\left(\frac{x}{3}\right)^2+\left(\frac{y}{4}\right)^2-\left(\frac{z}{3}\right)^2=1$.

a) Identify and sketch the intersections of this surface with the coordinate planes.

b) Sketch the surface in 3D, with coordinate system visible.

6. (10pts) Sketch the following set of points given in cylindrical coordinates:

$\frac{\pi}{6} \leq \theta \leq \frac{\pi}{3}$, $r > 2$

7. (12pts) Sketch the point whose rectangular coordinates are $(-2, -2, \sqrt{\frac{8}{3}})$ and find its spherical coordinates.

Bonus (10pts) Refer to the parallel lines of problem 4.
a) Show that the lines are not identical. *(Hint: show a point on one line is not on the other.)*
b) Find the distance between those lines. *(Hints: one way uses the area of a parallelogram. Another uses a plane perpendicular to the lines.)*