

## Homework 1

Due January 19th in class or by 3:20 pm in MATH 602.

1. Find all vectors in  $\mathbb{R}^3$  perpendicular to both  $\mathbf{i} + \mathbf{j}$  and  $\mathbf{i} - \mathbf{j} + \mathbf{k}$ .
2. Find an equation for the plane which is perpendicular to the vector  $(1, 2, 3)$  and passes through the point  $(1, 1, 1)$ .
3. Find the volume of the parallelepiped spanned by  $(1, 1, 1)$ ,  $(1, -2, 3)$ , and  $(-3, 2, -1)$ .
4. Find the intersection of the planes with equations  $x + 2y + 4z = 7$  and  $4x + 2y + z = 7$ .

5. Sketch the region given in spherical coordinates by the inequalities

$$0 \leq \rho \leq 1, \quad 0 \leq \theta \leq \pi, \quad 0 \leq \phi \leq \pi/2.$$

Express this region in cylindrical coordinates.

6. Sketch the region given in spherical coordinates by the inequalities

$$0 \leq \rho \leq 1, \quad 0 \leq \theta \leq \pi/2, \quad 0 \leq \phi \leq \pi.$$

Express this region in cylindrical coordinates.

7. Expand and simplify  $\|\mathbf{u} + \mathbf{v}\|^2 + \|\mathbf{u} - \mathbf{v}\|^2$ .
8. Expand and simplify  $\|\mathbf{u} + \mathbf{v}\|^2 - \|\mathbf{u} - \mathbf{v}\|^2$ .