

MATH 2425  
CALCULUS II  
Lab 12: Week of November 23, 2009  
Vectors and Geometry of Space

**Problem 1.** Find the acute angle formed by two diagonals of a cube.

**Problem 2.** Where does the line  $x = 1 + t$ ,  $y = 3 - t$ ,  $z = 2t$  intersect the cylinder  $x^2 + y^2 = 16$ ?

**Problem 3.** Two bugs are walking along lines in 3-space. At time  $t$ , bug 1 is at the point  $(x, y, z)$  on the line  $x = 4 - t$ ,  $y = 1 + 2t$ ,  $z = 2 + t$ . At the same time, bug 2 is at the point  $(x, y, z)$  on the line  $x = t$ ,  $y = 1 + t$ ,  $z = 1 + 2t$ . Assume the distance is in centimeters and the time is in minutes.

1. Find the distance between the bugs at time  $t = 0$ .
2. What is the closest distance possible between the 2 bugs?

**Problem 4.** Given nonzero vectors  $\mathbf{u}$ ,  $\mathbf{v}$ , and  $\mathbf{w}$ , use dot product and cross product notation to describe the following.

1. A vector orthogonal to  $\mathbf{u} \times \mathbf{v}$  and  $\mathbf{u} \times \mathbf{w}$ ;
2. A vector orthogonal to  $\mathbf{u} + \mathbf{v}$  and  $\mathbf{u} - \mathbf{v}$ ;
3. A vector of length  $|\mathbf{u}|$  in the direction of  $\mathbf{v}$ ;
4. The area of the parallelogram determined by  $\mathbf{u}$  and  $\mathbf{w}$ .