Problem 2.1. We have seen many question of the form "what is the distance between this (point/line/plane) and this other (point/line/plane)?" Another version of this question is "What is the equation of the plane which contains this (point/line) and also (contains/is orthogonal to) this other (line/plane)?" Finally, we seen questions like "What is the angle between this (line/plane) and this other (line/plane)?"

Make up a problem of one of the above types (make sure the numbers work out nicely!) and write it on the board. Solve all of the other problems written on the board. (If any are sufficiently interesting, I'll use it on the midterm.)

Problem 2.2. Suppose that $L(t) = (t, 0, -1)$ and $M(s) = (0, s, 1)$ are two lines in three-space. Let S be the set of points *equidistant* from L and from M: that is, every point $p \in S$ has the *same* distance to both L and to M. Give a sketch of S. Describe S implicitly, as the set of solutions of some equation. What are the cross sections of S by planes of the form $z = c$, $c \in \mathbb{R}$?

Problem 2.3 (Very challenging). Show that for any ellipsoid $E : \frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ there is a plane P so that

- $(0, 0, 0) \in P$ and
- the cross section $E \cap P$ is a circle.

Conversely, find a quadric surface Q so that, for *any* plane P, the cross section $Q \cap P$ is *not* a circle. Generally, classify the quadric surfaces which do have a round cross section, and those that don't. (Eg, does the elliptic paraboloid have a round cross section? Play around with Maple!)