The following is the outline I gave to the TA’s for the first day of class.

**Opening day of Calculus III (Sep. 4–5, 2003)**

I. **Orientation materials** (apologize to the sophomores, though they may need to hear it anyway).

   A. Discuss the two basic lines from page 11 of the Arts & Sciences Freshman Academic Handbook:
      1. *In college, most of the learning takes place outside the classroom.*
      2. *It is the student’s responsibility to learn the material.*

II. **Vectors in the plane** (Presume cartesian coordinates.) Vectors as something with magnitude and direction (location not specified).

   A. Displacement vectors; position vectors as special case; \( (a, b) \) as notation for position vector of the point \( (a, b) \).

   B. For \( \vec{v} \), length (or magnitude) \( ||\vec{v}|| \); \( ||(a, b)|| \); scalar multiplication, *vector sum*, both in coordinates and geometrically; \( (a, b) \) as \( a\hat{i} + b\hat{j} \), where ...; vector in polar form: \( \vec{v} = ||\vec{v}|| \cdot \vec{u}_\theta \) where \( \vec{u}_\theta \) is unit vector in positive direction of \( \theta \).

   C. Dot product and perpendicularity.

III. **Various forms of equation of a line.**

   A. Slope-intercept: \( y = mx + b \), where ... (easiest, but furthest from the way one thinks of a line).

   B. Point-slope: \( y - y_0 = m(x - x_0) \), where ... (a point and a direction determine a line); don’t omit the vertical lines \( x = x_0 \).

   C. Two points determine a line, for they determine the slope, and a pair of choices for the point, cf. B.

   D. Point-normal \( ax + by = c \), where \( (x_0, y_0) \) is the point, \( c = ax_0 + by_0 \) of course, and \( (a, b) \) denotes a normal (perpendicular) vector. Introduce vectors normal and tangent to (i.e., parallel to) a line; derive D from B.