MAT 2443: Exam 1   **Name:** _____
February 5, 2013.

No calculators, notes, or books are allowed. You may have only writing implements (including a ruler or other drawing aids) and blank paper.

Each numbered question is worth 20 points; any lettered parts of a question have the same value.

1. *Coordinate Geometry.*

   (a) Calculate the distance from the point $(1, 1, 1)$ to the origin $(0, 0, 0)$.

   (b) Calculate the distance from the point $(1, 1, 1)$ to the x-axis.

   (c) Calculate the distance from the point $(1, 1, 1)$ to the xy-plane.

   (d) Write an inequality describing the solid in $\mathbb{R}^3$ consisting of the points that lie on or inside the sphere of radius 2 with center at $(1, 1, 1)$. (That is, write an inequality whose solution is this set of points.)

2. *Vector Geometry*

   (a) Calculate the acute angle between the planes $x + y = 0$ and $y + z = 1$.

   (b) Calculate the distance between the parallel planes $x + y + z = 0$ and $x + y + z = \sqrt{3}$.

   (c) Calculate the angle between the x-axis and its orthogonal projection onto the plane $x + y + z = 0$.

   (d) Let $\mathbf{u} = (1, 1, 0)$, $\mathbf{v} = (0, 1, 1)$, and $\mathbf{w} = (1, 0, 1)$. Calculate the oriented volume of the parallelepiped determined by the ordered triple $(\mathbf{u}, \mathbf{v}, \mathbf{w})$.

3. *Lines & Planes*

    (a) Consider the lines given by the equations below:

- $l : x = y = z$
- $m : x = 1 - y, z = 0$

Do these lines intersect? If not, are they parallel?

    (b) Find an equation for the plane through the origin that is perpendicular to the line parametrized by $x = t, y = 2t, z = 1 + 3t$.

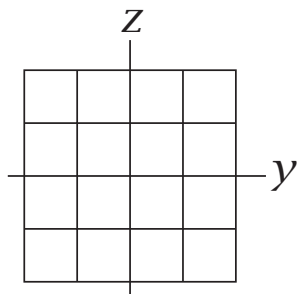4. Find an equation for the plane that passes through the three points $(1, 01)$, $(0, 1, 1)$, and $(0, 0, 2)$.

5. Consider the surface defined as the solution to the equation $y^2 - x^2 = z$.

(a) Write equation for the trace in the yz-plane of the cross-section perpendicular to the x-axis at $x = 0$. Sketch it on the grid provided below.
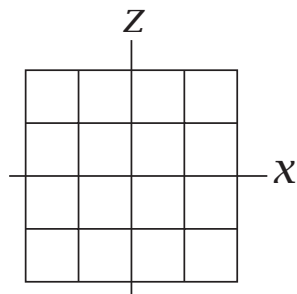
(b) Write equation for the trace in the xz-plane of the cross-section perpendicular to the y-axis at $y = 0$. Sketch it on the grid provided below.

(c) Write equations for the traces in the xy-plane of the cross-sections perpendicular to the z-axis at $z = -1$, $z = 0$, and $z = 1$. Sketch and label them on the grid provided below.

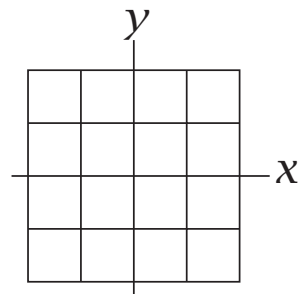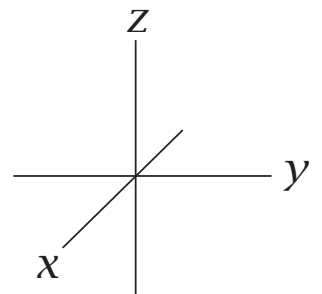(d) Sketch the surface using the axes provided.

(a)   (b)   (c)   (d)