1. Write parametric equations for the line along which the planes $x + 2y + 3z = 1$ and $2x + 5y - z = 2$ intersect.
2. Consider two lines, one passing through $(1, 0, 0)$ and $(0, 1, 0)$ and the other passing through $(0, -1, 0)$ and $(0, 0, 1)$. Find the minimum distance between them, as follows.

(a) Write parametric equations for both lines, using $s$ as the parameter for the first line and $t$ as the parameter for the second.

(b) Write a function $f(s, t)$ that gives the distance squared between the point on the first line at time $s$ and the point on the second line at time $t$.

(c) Find the minimum value of $f(s, t)$. 
3. Consider the surface \( z = \frac{y^2}{1 + x^2} \).

(a) Sketch the slices \( x = 0 \), \( x = \pm 1 \), and \( x = \pm 2 \).

(b) Sketch the slices \( y = 0 \), \( y = \pm 1 \), and \( y = \pm 2 \).

(c) Sketch the slice \( z = 1 \). Hint: multiply through by \( 1 + x^2 \).

(d) Sketch the surface. The slices you drew in parts (a) through (c) should appear in your sketch.
4. (a) In what direction is the function \( f(x, y) = x^2 - y^2 \) increasing most steeply at the point \((1, 2)\)? What is the slope in that direction? What is the slope in the direction \(\left\langle \frac{1}{2}, \frac{\sqrt{3}}{2} \right\rangle\)?

(b) Write an equation for the tangent plane to the surface \( y^2 + z^2 = x^3 - x \) at the point \((2, 2, \sqrt{2})\).
5. Consider the curve \( \vec{r}(t) = (t^2 - 2t + 1, t^2, 2t^2 - 2t) \).

(a) Find \( \vec{v}, \vec{T}, a_T, \vec{a}_\parallel, \vec{a}_\perp \), and \( a_N \) at time \( t = 1 \). Circle your answers. As a sanity check, make sure that \( \vec{a}_\perp \) is perpendicular to \( \vec{v} \).

(b) The curve meets the plane \( x + y + 2z = 1 \) at two points. One is \( (1, 0, 0) \); what is the other?
(c) Find the angle between the curve and the plane at those two points. Hint: First find the angle between the velocity vector to the curve and the normal vector to the plane; then think about what this has to do with the angle between the curve and the plane. Further hint: You can do this without a calculator, so the cosines in question must be among 0, $\pm \frac{1}{2}$, $\pm \frac{\sqrt{2}}{2}$, $\pm \frac{\sqrt{3}}{2}$, and $\pm 1$. 