1. (24 pts) Consider the points $P(0, 9, 2)$ and $Q(-2, 10, 5)$.
   (a) Find an equation for the set of points equidistant from point P and the plane $z = 7$. You may leave your answer unsimplified.
   (b) Let $\mathbf{v}$ equal the vector $\overrightarrow{PQ}$ and let $\mathbf{w} = \overrightarrow{PR} = \langle 4, 5, 1\rangle$, where R is another point in space.
      i. Find the distance between points Q and R.
      ii. Find the projection of $\mathbf{w}$ onto $\mathbf{v}$.
      iii. Find a unit vector orthogonal to $\mathbf{v}$ and $\mathbf{w}$.

2. (28 pts) Let L_1 and L_2 be the lines whose symmetric equations are
$$L_1 : \ x = \frac{y+4}{2} = \frac{z-1}{-2} \qquad L_2 : \ \frac{x}{-2} = \frac{y+4}{3} = \frac{z-1}{6}.$$
   (a) Write parametric equations for L_1 and L_2.
   (b) Find the point where L_1 intersects the xz plane.
   (c) Find the angle formed by L_1 and L_2.
   (d) Find an equation for the plane that contains L_1 and L_2.

3. (24 pts) Consider the surface $x^2 + y^2 - z^2 - 2x + 6y - 6 = 0$.
   (a) Write the equation in standard form.
   (b) Identify the surface.
   (c) Sketch the $z = 3$ trace.
   (d) Suppose the surface is intersected with the surface $z - y = 3$. Find vector equation(s) for the curve(s) of intersection.

4. (24 pts) A bug is traveling along a path. Its position at time t seconds is $\mathbf{r}(t) = t\,\mathbf{i} + 2t\,\mathbf{j} + \frac{2}{3}t^{3/2}\,\mathbf{k}$, measured in centimeters.
   (a) How far does the bug travel from $t = 0$ to 4 seconds? You may leave the final answer unsimplified.
   (b) Consider the plane $4x - y - z = 13$. Is the vector tangent to the path at $t = 4$ parallel to the plane, orthogonal to the plane, or neither?
   (c) At $t = 4$, the bug leaves the path and travels in a straight line in the direction of the tangent vector. Find a vector function represention $\mathbf{s}(t)$ for this straight path.