

1. (24 pts) Consider the points $P(0, 9, 2)$ and $Q(-2, 10, 5)$.
- Find an equation for the set of points equidistant from point P and the plane $z = 7$. You may leave your answer unsimplified.
 - 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.
 - Find the distance between points Q and R .
 - Find the projection of \mathbf{w} onto \mathbf{v} .
 - 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

$$L_1 : x = \frac{y+4}{2} = \frac{z-1}{2} \quad L_2 : \frac{x}{2} = \frac{y+4}{3} = \frac{z-1}{6}.$$

- Write parametric equations for L_1 and L_2 .
 - Find the point where L_1 intersects the xz plane.
 - Find the angle formed by L_1 and L_2 .
 - Find an equation for the plane that contains L_1 and L_2 .
3. (24 pts) Consider the surface $x^2 + y^2 - z^2 - 2x + 6y - 6 = 0$.
- Write the equation in standard form.
 - Identify the surface.
 - Sketch the $z = 3$ trace.
 - 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.
- How far does the bug travel from $t = 0$ to 4 seconds? You may leave the final answer unsimplified.
 - 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?
 - 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 representation $\mathbf{s}(t)$ for this straight path.