Problems of the Day Before Exam I

January 19: Describe in words the region in $\mathbb{R}^3$ represented by the inequality

$$x^2 + y^2 + 3y + z^2 - 2z > 4.$$

January 22: A 10-lb weight hangs from two wires as shown below. Find the tensions $T_1$ and $T_2$.

\[\text{Diagram of two wires meeting at an angle of 45 degrees, with a 10-lb weight at the point of intersection.}\]

January 24: Let $\ell_1$ be the line through the points $(1, 0, 0)$ and $(1, 2, 2)$, and let $\ell_2$ be the line through the points $(1, 1, 1)$ and $(1 + \sqrt{2}, 2, 2)$. Do $\ell_1$ and $\ell_2$ intersect? If so, at what point do they intersect?

January 26: Find an equation for the plane that contains the point $(3, -2, 5)$ and that is perpendicular to the line

$$\frac{x - 2}{3} = \frac{1 - y}{6} = \frac{z + 2}{2}.$$

January 29: Find all unit vectors perpendicular to the plane that contains the three points $P_1 = (1, 1, 1)$, $P_2 = (0, 2, 1)$, and $P_3 = (2, -2, 2)$.

January 31: Consider the two lines

$$x = y = z$$

and

$$\frac{x - 1}{2} = \frac{y - 1}{3} = z - 1.$$

1. What is an easy way to see that they intersect?
2. Find an equation for the plane that contains these two lines.

February 2: Find an equation for the line tangent to the curve

$$\mathbf{r}(t) = e^t \mathbf{i} + 2 \sin t \mathbf{j} + (t^2 - 2) \mathbf{k}$$

at the point $(1, 0, -2)$.

February 5: Find the arc length of the curve

$$\mathbf{r}(t) = \cos t \mathbf{i} + \sin t \mathbf{j} + \frac{2}{3} t^{3/2} \mathbf{k}$$

from $t = 0$ to $t = 4\pi$.  