Instructions: By Friday, October 7, complete all 6 problems below. You must submit your own work on these problems though you may certainly discuss the problems with me or with one another. Your final submission must be in your own words, not copied from a shared document. I will grade each problem on a 0/1 scale and add a maximum of 6 points to your Exam 1 score.

1. The three points $O(0,0,0)$, $P(1,2,3)$ and $Q(3,1,8)$ determine a unique plane that passes through the origin. Find the equation of this plane in the form $ax + by + cz = d$.

2. It is possible for a pair of vectors $u$ and $v$ to satisfy $u \cdot v = \|u \times v\|$. What must be true about the angle between $u$ and $v$ for this to happen? Be very specific.

3. The planes $3x + 2y + z = 7$ and $-3x + 2y - z = 9$ intersect in a line. Find a vector equation for this line of intersection.
4. The vertices $A(1, 2, 3)$, $B(3, 3, 5)$, and $C(2, 0, 3)$ determine a triangle. Use the dot product to demonstrate that this is a right triangle, and then find the area of $\triangle ABC$.

5. Prove that $\|v + w\|^2 = \|v\|^2 + \|w\|^2$ if and only if $v$ is perpendicular to $w$.

6. Prove that $\frac{d}{dt}(\mathbf{r}(t) \times \mathbf{r}'(t)) = \mathbf{r}(t) \times \mathbf{r}''(t)$ for any twice-differentiable vector function $\mathbf{r}(t)$.