**These problems are samples of final-like problems.**

**These problems do not constitute a comprehensive review for the final**.

**1.** Find the equation of the plane that contains the points $(0,1,2)$, $(-1,2,3)$, and $(-4,-1,2)$. Demonstrate (i.e., check) that your answer is correct.

**2.** Find the cosine of the angle $\theta$ between the vectors $\vec{A} = \langle 1, 2, 2 \rangle$ and $\vec{B} = \langle -3, 4, 0 \rangle$.

**3.** Let $c$ be a constant (real number). Consider the two vectors $\vec{A} = \langle 1, -2, 2 \rangle$ and $\vec{B} = \langle -1, 0, c \rangle$. Find a value of $c$ so that $\vec{A} \perp \vec{B}$.

**4.** Let $\vec{u} = \langle -1, 5 \rangle$ and $\vec{v} = \langle 3, 3 \rangle$. Find the vector projection of $\vec{u}$ onto $\vec{v}$.

**5.** Let $\vec{u} = \langle -1, 5 \rangle$ and $\vec{v} = \langle 3, 3 \rangle$. Find the (scalar) component of $\vec{u}$ onto $\vec{v}$.

**6.** Find an equation of the plane tangent to the surface defined by $3xy + z^2 = 4$ at the point $(1,1,1)$.

**7.** Find the arc length of the curve $\vec{c}\,(t) = \langle t - \sin t, 1 - \cos t \rangle$ for $0 \le t \le 2\pi$.
Integration Hint: the Half-Angle Formulas are $\cos^2 x = \frac{1+\cos(2x)}{2}$ and $\sin^2 x = \frac{1-\cos(2x)}{2}$.

**8.** Find the directional derivative of $f(x,y,z) = x^3 - xy^2 - z$ at the point $P = (1,1,0)$, in the direction of $\vec{v} = 2\vec{\imath} - 3\vec{\jmath} + 6\vec{k}$.

**9.** Find all points $(x,y)$ where a local maximum, local minimum, or saddle point occurs for the function $f(x,y) = xy - x^2 - y^2 - 2x - 2y + 4$.

**10.** Find the area of the region bounded by $y + x^2 = 2$ and $y + x = 0$. (Draw a meaningful picture.)