Math 251
Practice Test 2a

1. [15 points] Let $f(x, y, z) = x^2y + zxy + z^2 + 2x$. What is the rate of change of the value of f with respect to t (time) at the point $(1, 2, 1)$ as we move according to $\mathbf{r}(t) = \langle 3, 2, -1\rangle\, t + \langle 1, 2, 1\rangle$?

2. [15 points] Let $f(x, y) = x^3y^2 - 3xy$. Find the equation in standard form of the plane tangent to the surface $z = f(x, y)$ at the point $(1, 2)$.

3. [10 points] Minimize $f(x, y) = x^2 - y^2$ subject to the constraint $x - 2y + 6 = 0$. How do you know it is a minimum and not a maximum?

4. [10 points] Find $\frac{\partial z}{\partial x}$ where $x^3 + y^3 + z^3 + 6xyz = 9$ at the point $(1, 1, 1)$.

5. [15 points] Find and classify the relative extrema of $f(x, y) = x^3 - 2xy + y^2$.

6. [15 points] Find the volume inside the cylinder $x^2 + y^2 = 1$, above the xy-plane and below the plane $2x + 3y - z = -6$.

7. [15 points] Let $r = 2\sin 3\theta$. Graph this in polar coordinates. Find the total area enclosed.

8. [10 points] Set up but do not evaluate the integrals needed to find the *radius of gyration* about the x-axis for the lamina corresponding to the region given by: $0 \le y \le \sin x$, $0 \le x \le \pi$, where the density function is $\rho(x, y) = x$.