Name:

Please complete 5 out of 6 problems. If you complete 6 out of 6, I will use your top 5 scores for your grade.

1. Let $\mathbf{F}(x, y) = x^3y^4\mathbf{i} + x^4y^3\mathbf{j}$.

a. Find a function f such that $\mathbf{F} = \nabla f$.

b. Use the Fundamental Theorem of Line Integrals to evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ along the curve $\mathbf{r}(t) = \sqrt{t}\mathbf{i} + (1 + t^3)\mathbf{j}, 0 \leq t \leq 1$.

2. Use Green's Theorem to evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F}(x, y) = \langle y \cos x - xy \sin x, xy + x \cos x \rangle$ where C is the triangle from $(0, 0)$ to $(0, 1)$ to $(1, 0)$ to $(0, 0)$.

3. Find the area of the surface that is the part of the plane $2x+5y+z=10$ that lies inside the cylinder $x^2+y^2=9$.

4. Evaluate the surface integral $\iint_S x^2 z^2 \, dS$ where S is the part of the paraboloid $z = \sqrt{x^2 + y^2}$ given by $0 \le z \le 1$.

5. Let $\mathbf{F}(x, y, z) = \mathbf{i} + (x + yz)\mathbf{j} + (xy - \sqrt{z})\mathbf{k}$.

a. Compute curl$\mathbf{F}$

b. Use Stokes' Theorem to compute $\int_C \mathbf{F} \cdot d\mathbf{r}$ where C is the boundary of the part of the plane $x + 2y + 3z = 1$ in the first octant, where C is oriented ccw when viewed from above.

6. Let $\mathbf{F}(x, y, z) = (2x^2 + z^2)\mathbf{i} + (z^2 - 2x)\mathbf{j} + (y^2 + x)\mathbf{k}$.

a. Compute div$\mathbf{F}$.

b. Use the Divergence Theorem to compute $\iint_S \mathbf{F} \cdot d\mathbf{S}$, where S is the part of the cone $x = \sqrt{y^2 + z^2}$ between the planes $x = 0$ and $x = 1$.