1. (20 pts) The downward oriented surface $S$ is the part of the plane $2x - 3y + 5z = 0$ that is inside the cylinder with equation $x^2 + y^2 = 1$. Compute the flux through this surface of the vector field $\vec{G}(x, y, z) = (2x, x - y, y + z)$. 
2. (20 pts) The curve $P$ is parametrized by $\vec{x}(t) = (t^2 + e^{t(t-1)}, t^4 - 3t^3 + 2t, \cos(\pi t))$, with $0 \leq t \leq 1$. Compute $\int_P \vec{F} \cdot \vec{T} \, ds$, where $\vec{F}(x, y, z) = \langle 3x^2y + zex^z, x^3, xe^{xz} \rangle$. 

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3. (20 pts) A gas cloud in space, with density given by $\delta(x, y, z)$, creates a gravitational field near the origin described by

$$\vec{F}_g = \left< 3 + 4x - 2y + 3x^2 - 4y^2, 2 - 2x + 2y - z + xy - y^2, 5 - x - y - 5z + xz - y^2 - z^2 \right>$$

Compute $\frac{\delta(1, 0, 0)}{\delta(0, 0, 0)}$. 
4. (20 pts) The curve $C$ is parametrized by $\vec{x}(t) = (\cos t, \sin t, \cos t \sin t)$, with $0 \leq t \leq 2\pi$. Compute the line integral along this curve of the vector field $\vec{F}(x, y, z) = (x^2 - 2y, 2e^y - z, z^3 + 3x)$. (Hint: You might be able to make use of an algebraic relationship between the functions describing $x$, $y$, and $z$ on the curve.)
5. (20 pts) The inward oriented surface $S$ is in the shape of a left hand glove with the fingers pointing up, the thumb pointing in the direction of the $x$-axis, and the opening at the wrist is the curve in the $xy$-plane with equation $4x^2 + 9y^2 = 36$. Compute the flux through this surface of the vector field

$$\vec{F}(x, y, z) = \langle y^2z - z^2, 4 - xy, 3 + xz \rangle$$