

Name: _____

Please show all work and explain your answers. Sketch.

1. (20 pts.) Find the arc length of the helix $\gamma(t) = (3 \cos(t), 3 \sin(t), 2t)$ between $(3, 0, 0)$ and $(0, 3, \pi)$. Sketch.
2. (20 pts.) Find the flux of $F(x, y, z) = (3, x, z)$ through the surface $x^2 + y^2 + z^2 = 4, z \leq 0$. Sketch the surface and F at several points on the surface.
3. (20 pts.) Find the work done by the force field $F(x, y, z) = (x + 1, y + 2, z + 3)$ in moving a particle from the origin to $(1, -1, 2)$. Does it matter along which path the particle is moved? Explain.
4. (20 pts.) Let $F = (6xz^2, 2y^3, 6zx^2)$ and $\omega = F \cdot dS$, where $dS = (dy dz, dz dx, dx dy)$.
 - (a) Compute $d\omega$.
 - (b) Use the general fundamental theorem of calculus to express the flux of F through the unit sphere as a density integral with respect to $dx dy dz$. Evaluate this integral.

1	2	3	4	total (80)	(%)