Name: _____

Score: _

Instructions: You must show supporting work to receive full and partial credits. No text book, notes, formula sheets allowed.

1(15pts) (a) Find a parameterized equation for the line from P(1,2,3) to Q(3,2,1).

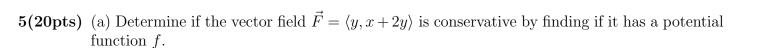
(b) Find the flux of the vector field $\vec{F} = \vec{i} + 2\vec{j} + 3\vec{k}$ through the rectangle with vertices (0,0,1),(1,0,0),(1,2,0),(0,2,1), oriented upward.

2(15pts) Let C be the helix $x(t) = 2\cos(t), y(t) = 2\sin(t), z(t) = t$ for $0 \le t \le 2\pi$. Find the line integral of the vector field $\vec{F}(x,y,y) = -y\vec{i} + x\vec{j} + z\vec{k}$ along C.

- **3(20pts)** Let $\vec{F}(x, y, z) = xy\vec{i} + yz\vec{j} + zx\vec{k}$
 - (a) Find the divergence of $\vec{F}(x, y, z)$ at the point (1, 2, 3).
 - (b) Find the curl of $\vec{F}(x, y, z)$ at the same point (1, 2, 3).

(c) Find the circulation density $\operatorname{circ}_{\vec{n}} \vec{F}(1,2,3)$ of \vec{F} and in the direction of $\vec{v} = \langle 1,1,1 \rangle$.

4(15pts) If the curl of a vector field $\vec{F}(x,y,z)$ is given as $\text{curl}\vec{F}(x,y,z) = (y-x)\vec{i} + x\vec{j} + z\vec{k}$. Use Stoke's Theorem to find the line integral of $\vec{F}(x,y,z)$ around the triangle with vertex (0,0,2),(2,0,0),(0,2,0) on the plane z=2-x-y, oriented counterclockwise when viewed from above.



(b) Find the line integral $\int_C \vec{F} \cdot d\vec{r}$ of the vector field along the path C which is part of an ellipse from (1,0) to (0,2). (Use the Fundamental Theorem of Line Integral if possible.)

6(15pts) Use the Divergence Theorem to find the flux of the vector field $\vec{F}(x,y,z) = (x+y^2)\vec{i} + (y+z^2)\vec{j} + (z+x^2)\vec{k}$ through the surface of the solid cylinder: $x^2+y^2=2, 0 \le z \le 1$, centered along the z-axis and oriented outward.