1. Let C be the boundary of the surface $z = x^2 + y^2$ with $0 \le x \le 2$ and $0 \le y \le 1$, oriented with upward facing normal. Define $\mathbf{F}(x, y, z) = (\sin(x^3) + xz, x - yz, \cos(z^4))$ and evaluate

$$\int_C \mathbf{F} \cdot d\mathbf{s}$$

2. The helicoid surface S is parametrized by $\mathbf{X}(s, t) = (s\cos(t), s\sin(t), t)$ for $0 \le s \le 1$ and $0 \le t \le \pi/2$. Compute the line integral

$$\oint_{\partial S} \mathbf{F} d\mathbf{s}$$

For the function $\mathbf{F}(x, y, z) = z\mathbf{i} + x\mathbf{j} + y\mathbf{k}$

3. Let S be the hemisphere $x^2 + y^2 + z^2 = 4$ with $z \ge 0$ oriented upwards. Let $\mathbf{F}(x, y, z) = \left(x^2 e^{yz}, y^2 e^{xz}, z^2 e^{xy}\right)$ be a vector field. Evaluate:

$$\iint_S \text{curl } \mathbf{F} \cdot d\mathbf{S}$$

4. Let $\mathbf{F}(x, y, z) = (xy, e^{z^2} + y, x + y)$ and let S be the graph of the function $y = x^2/9 + z^2/9 - 1$ with $y \leq 0$ oriented so that the normal vector S has positive y component. Compute the integral

$$\iint_S \nabla \times \mathbf{F} \cdot d\mathbf{S}$$

5. Use Stokes' Theorem to evaluate $\oint \mathbf{F} \cdot ds$ where $\mathbf{F}(x, y, z) = (y, z, x)$ and C is the triangle with vertices $(0, 0, 0), (2, 0, 0)$ and $(0, -2, 2)$ oriented counterclockwise when viewed from above.

6. The height of a mountain at a point (x, y) is given by $z = 2 - x^2 - y^2$. You walk counterclockwise around the mountain on the boundary of the region R defined by $-1 \leq x \leq 1$ and $-1 \leq y \leq 1$. A magnetic field is exerting force $\mathbf{F}(x, y, z) = (x^2 y, 2x(y^2 + z), z^3)$ on your compass. Use Stokes' theorem to calculate the work done by the magnetic field as you walk around the mountain.