1. Suppose \( F = 2xyi + (x^2 + nyz)j + y^2k \).
   
   A. For what number \( n \) does \( \text{curl}(F) = 0 \)?
   
   B. For this number \( n \), find \( f \) so that \( \nabla(f) = F \).

2. Let \( F = \langle 1 + \tan(x), x^2 + e^y \rangle \) be a force field. Let \( C \) be the boundary of the region enclosed by the parabola \( x = y^2 \) and the lines \( x = 1 \) and \( y = 0 \). Find the work done by \( F \) as a particle travels once around \( C \) in the counterclockwise direction.

3. Find a vector field \( F \) such that \( \int_C F \cdot dr = 0 \) whenever the endpoints of \( C \) both lie on the curve \( y = x^3 + x + 1 \).

4. Consider the surface \( S \) in \( \mathbb{R}^3 \) given parametrically by \( x = u \cos(v), y = u \sin(v), \) and \( z = u \). Let \( (u, v) \) range through the domain \( D = \{(u, v)|0 \leq u \leq 1, 0 \leq v \leq 2\pi\} \).
   
   A. Graph \( S \). Mark the grid curves \( u = 1 \) and \( v = 0 \).
   
   B. Find the surface area (for \( (u, v) \in D \)).
   
   C. Let \( C \) be the grid curve \( v = 0, 0 \leq u \leq 1 \). Find \( \int_C 1ds \). What physical quantity does this integral represent?

5. Suppose \( F = \langle yz, yz^2, z^3e^{xy} \rangle \). Suppose \( S \) is the part of the sphere \( x^2 + y^2 + z^2 = 5 \) above \( z = 1 \) oriented upwards. Find \( \int_S \text{curl}F \cdot dS \).

6. Suppose \( F = \langle 3x, xy, 2xz \rangle \). Suppose \( S \) is the boundary of the cube \( \{(x, y, z)|0 \leq x \leq 1, 0 \leq y \leq 1, 0 \leq z \leq 1\} \). Find the flux of \( F \) across \( S \).