1. Let \( \mathbf{F} = (2xz + y^2)i + (z^2 + 2xy)j + (2yz + x^2 + 1)k. \)
   (a) Show that \( \mathbf{F} \) is conservative and find a function \( f \) such that \( \mathbf{F} = \nabla f. \)
   (b) Compute \( \int_C \mathbf{F} \cdot d\mathbf{r} \) where \( C \) is the curve
   \[
   x = t^5, \quad y = \cos^3 \pi t/2, \quad z = \sin^3 \pi t/2, \quad 0 \leq t \leq 1.
   \]

2. Compute \( \int_C -y^3 \, dx + (x^3 - y) \, dy \) where \( C \) is the circle \( x^2 + y^2 = 1 \) oriented counterclockwise.

3. Use Stokes’ theorem to evaluate \( \int_C \mathbf{F} \cdot d\mathbf{r} \) where \( \mathbf{F} = -3yi + z^2j + xk \) and \( C \) is the triangle with vertices \((1, 0, 0), (0, 1, 0)\) and \((0, 0, 1)\) with counterclockwise orientation as viewed from above.

4. Evaluate \( \int \int_\Sigma \mathbf{G} \cdot \mathbf{n} \, dS \) where \( \mathbf{G}(x, y, z) = xi + yj + z^2k, \) \( \mathbf{n} \) is the outward normal and \( \Sigma \) is the boundary of the solid region bounded below by the cone \( z = \sqrt{x^2 + y^2} \) and above by the plane \( z = 1. \)