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
   
   \[ x = t^5, \quad y = \sin^3 \pi t/2, \quad z = 1 + \cos^3 \pi t/2, \quad 0 \leq t \leq 1. \]

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’s Theorem to compute $\int_C \mathbf{F} \cdot d\mathbf{r}$ where
   
   $\mathbf{F}(x, y, z) = z^2i + x^2j + y^2k; \quad C$ is the triangle with vertices $(0, 0, 0), (1, 0, 0)$ and $(0, 1, 1)$ oriented counterclockwise as viewed from above. (Hint: The triangle is contained in the plane $z = y$.)

4. Evaluate $\int \int_{\Sigma} \mathbf{G} \cdot \mathbf{n} \, dS$ where $\mathbf{G}(x, y, z) = xi + yj + z^2k$. 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 $z = 1$. 