1. Use Green's theorem to evaluate the line integral $\int_C (x^3 - y^3)\,dx + (x^3 + y^3)\,dy$ if C is the circle $x^2 + y^2 = 4$ oriented counter-clockwise.

2. Let $\mathbf{F}(x, y) = (3x^2 - 6y^2)\mathbf{i} + (-12xy + 4y)\mathbf{j}$.

   (a) Show that $\mathbf{F}$ is conservative.

   (b) Find a function $f(x, y)$ such that $\mathbf{F} = \nabla f$.

   (c) Let C be the curve consisting of the straight line from $(1, 2)$ to $(-1, 2)$ followed by the straight line from $(-1, 2)$ to $(2, -1)$. Calculate $\int_C \mathbf{F} \cdot d\mathbf{r}$.