Problem 1. Let $C$ be a smooth oriented curve in the plane and let $-C$ denote the same curve with the opposite orientation.

1. Verify that $\int_{-C} f(x, y) \, ds = \int_{C} f(x, y) \, ds$
2. Verify that $\int_{-C} f(x, y) \, dx = -\int_{C} f(x, y) \, dx$

Hint: given a parametrization $r(t), a \leq t \leq b$, of $C$, find a parametrization of $-C$.

Problem 2. Decide whether or not each of the following vector fields is conservative. If the vector field is conservative, find a potential function.

1. $F(x, y) = (4x - y, 6y - x)$
2. $F(x, y) = (2xy^2 + 3x^2, 3x^2y + 4xy^2)$
3. $F(x, y) = (3x^2 + 2y^2, 4xy + 6y^2)$

Problem 3. A vector field in $\mathbb{R}^3$ is central if it has the form

$$F(r) = \frac{Cr}{|r|^3}$$

where $r = (x, y, z)$. (Examples include gravity and electric force.) Find the work done by a central field on a particle which moves once counter-clockwise around the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ in the $xy$-plane.