1. Evaluate \( \iint_R x + y \, dA \) where \( R \) is the region bounded by the curves

\[
y = -x, \quad y = 2 - x, \quad y = x^3, \quad y = (x - 1)^3 - 1
\]

in the following two ways:

(a) as a sum of double integrals.
(b) using a transformation.

2. Compute the following line integrals

(a) \( \int_C xy \, ds \) where \( C \) is the line segment from the point \((1, 2)\) to the point \((3, 5)\).

(b) \( \int_C xy \, ds \) where \( C \) is the lower half of the circle of radius 1 about the origin starting at the point \((1, 0)\) and ending at the point \((-1, 0)\).

3. Let \( \mathbf{F} \) be the force field

\[
\mathbf{F}(x, y) = \langle xy, 0 \rangle
\]

(a) Compute the work required to move from the point \((1, 1)\) to the point \((-1, 1)\) along a straight line segment.
(b) Compute the work required to move from the point \((1, 1)\) to the point \((-1, 1)\) along the circle of radius \(\sqrt{2}\) centered at the origin.

4. Let \( \mathbf{F} \) be the vector field

\[
\mathbf{F}(x, y) = \langle -y, x \rangle
\]

and \( C \) be the loop bounding the polar rectangle

\[
R = \{ (r, \theta) \mid a \leq r \leq b \text{ and } \alpha \leq \theta \leq \beta \}
\]

oriented counter-clockwise.

(a) Do you expect the circulation of \( \mathbf{F} \) about \( C \) to be positive, negative or zero?
(b) Compute the circulation of \( \mathbf{F} \) about \( C \).
(c) For \( p \geq 0 \) let \( \mathbf{F}_p \) be the vector field

\[
\mathbf{F}_p(x, y) = \left\langle \frac{-y}{(x^2 + y^2)^{p}}, \frac{x}{(x^2 + y^2)^{p}} \right\rangle.
\]

Is there a value of \( p \) for which the circulation of \( \mathbf{F}_p \) is 0 for \( C \)?