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 a 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

$$R = \{(r,\theta) \,|\, a \le r \le b \text{ and } \alpha \le \theta \le \beta\}$$

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 $p \ge 0$ 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?